AERIAL AGE
WEEKLY

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WELCOME! THE AERIAL ERA

Review of Aviation in 1920

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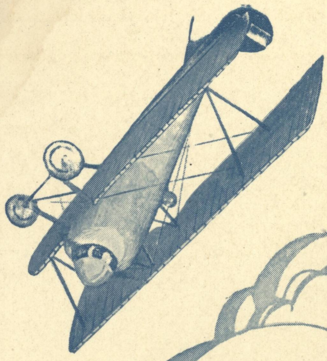

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properly understood and **scientifically used** in flying training saves time, money, and wear and tear on planes, motors and instructors.

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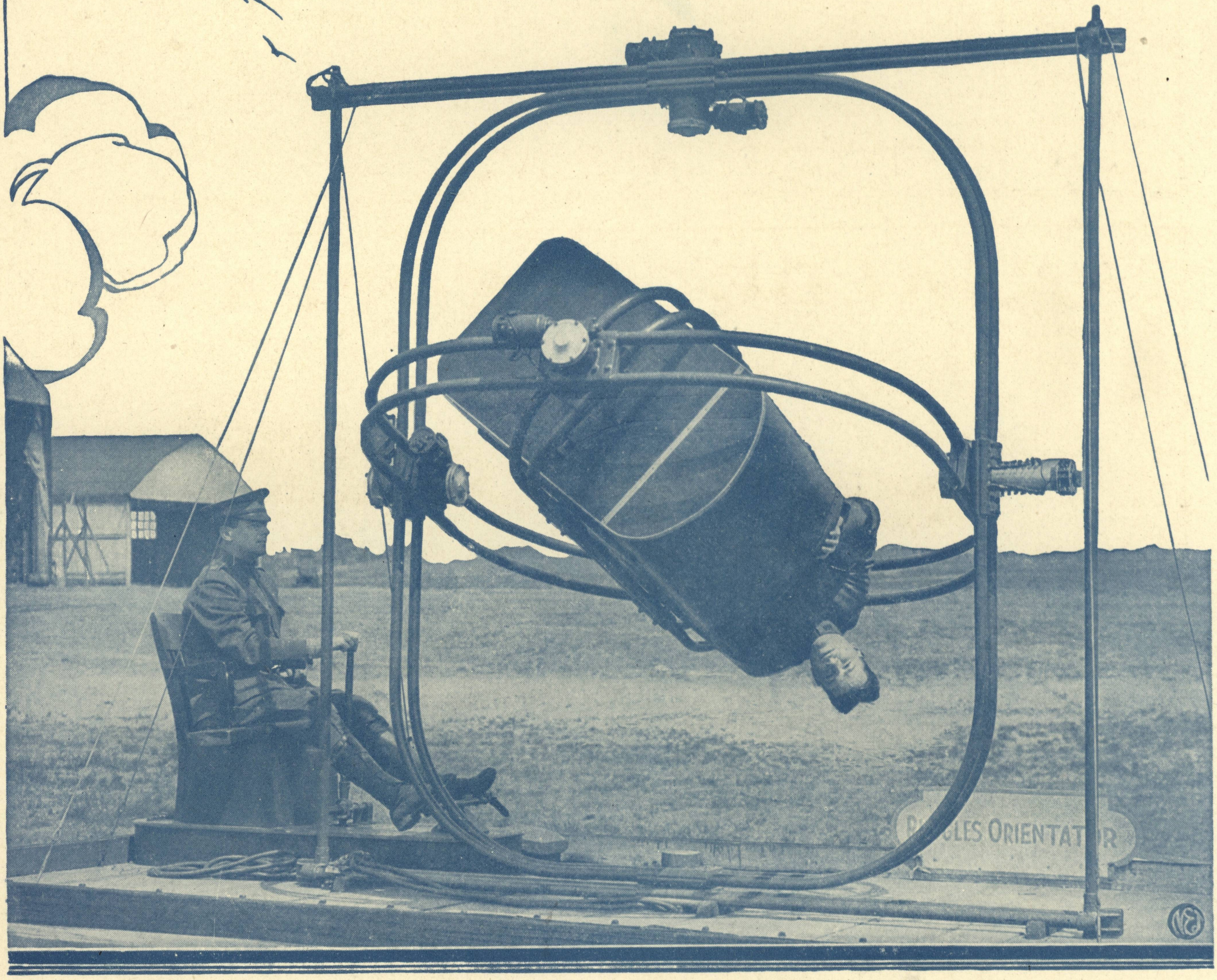

THE RUGGLES ORIENTATOR CORPORATION, 168 West 73d St., New York City

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JANUARY 10, 1921

AERIAL AGE
WEEKLY

VOL. XII, No. 18

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Textbook *of* Aero Engines

By

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Consulting Engineer

Consulting Engineer to Airplane Engineering Department, U. S. War Department,
Consulting Engineer to Naval Consulting Board

and

G. DOUGLAS WARDROP

Editor of "Aerial Age Weekly"

Member Aerial League of America, Society of Automotive Engineers, American
Society of Mechanical Engineers, American Society of
Naval Engineers, Franklin Institute, etc.

DEVELOPMENTS of tremendous importance in aero engines occurred during the war period, and realizing that there was not available an authoritative work of a thoroughly up-to-date character on aero engines, The Frederick A. Stokes Company arranged with E. H. Sherbondy and G. Douglas Wardrop to prepare a comprehensive volume, dealing with the principles and theory of aero engines, and describing completely all of the successful aero engines that have been developed during the war.

This volume will comprise 400 pages of large size, seven inches by ten, presenting a very full discussion of every important phase of the subject and also the presentation of photographs and diagrams of a size to be of value to the designing engineer and student.

The work has been prepared for the purpose of having in one volume the complete information concerning all modern types of aero engines and an up-to-the-minute discussion of the principles of aero engine design and construction, so that the reader may be able to undertake comparative research without recourse to a formidable list of volumes and publications, which in any event could only supply him with more or less obsolete information.

TO THE FREDERICK A. STOKES COMPANY,
443 Fourth Avenue, New York.

Please send me a copy of the Textbook of Aero Engines, by Sherbondy and Wardrop, for which I enclose my check for ten dollars herewith.

(Signed)...

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THE NATIONAL TECHNICAL, ENGINEERING AND TRADE AUTHORITY

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VOL. XII NEW YORK, JANUARY 10, 1921 NO. 18

REVIEW OF AVIATION IN 1920

THE Manufacturers Aircraft Association has prepared a comprehensive statement concerning aeronautic progress during 1920, as follows:

Despite many handicaps such as lack of aerial laws, landing fields and a strong Government policy, aircraft designed and built in America maintained a high rate of efficiency during 1920.

Decreased production and a general contraction in the aeronautical industry, generally, is offset by the more encouraging records of performance made in American aviation this year.

While the last twelve months have not brought the definitely outlined policy of federal jurisdiction required to assure steady and economical progress in commercial aerial navigation, they have witnessed remarkable achievements by American pilots flying American machines.

Commander A. C. Read, hero of the transatlantic flight in the N. C.-4, commanded the same flying boat on a noteworthy expedition from Rockaway, L. I., N. Y., down the Atlantic Coast, along the Gulf Coast and up the Mississippi River to Cairo, Ill. When the N. C.-4 returned to Rockaway, January 27th last, it had flown 7,740 nautical miles. Three of the four Packard Liberty engines had operated without trouble during the 118 hours in the air, the fourth more than 82 hours. Along the Mississippi the motors were run on commercial gasoline picked up from point to point en route. Read reported that the greatest difficulty encountered was lack of proper maps.

Compared to long flight attempts conducted by European Governments the American ventures were particularly successful. No less than four expeditions attempted to fly the 5,206 miles from Cairo to Capetown, Africa. Col. P. Van Ryndveld and Major C. J. O. Brand finally completed their flight on March 20, 1920, in a D.H.-9 plane sent up by the Government of the Union of South Africa after their Vickers-Vimy machine had crashed. They had set out from Cairo February 10th. None of the machines that started reached Capetown.

Different success attended the Alaskan Flying Expedition of the U. S. Army Air Service. Four Gallaudet remodelled D.H.-4-B planes, each powered with a single Liberty motor, and each carrying two persons, flew from Mitchel Field, L. I., N. Y., to Nome, Alaska, and return in 112 hours flying time—a total distance of 9,000 miles, without a motor missing fire or other accident serious enough to delay the party. Rain and fog caused most of the difficulty in flying over country not even charted on the maps.

The Air Mail in 1920 operating between New York and Washington, New York, Cleveland, Chicago, Omaha, Salt Lake City, and San Francisco, transported approximately one hundred million letters at ordinary postage rates. The system was extended in 1920 from Chicago to San Francisco—from Key West, Fla., to Havana, Cuba, and from Seattle, Wash., to Victoria, B. C. About 35 Air Mail planes are in the air each day flying a total, in round trips, of about 8,000 miles.

During the year the Navy has been making an aerial survey of the Panama Canal Zone.

The Geological Survey has co-operated with the Marine Corps in mapping the coastline of Haiti. American seaplanes, Curtis, Aero-marine and Boeing types, have operated on passenger routes in China.

Major R. W. Schroeder, flying an American designed and built Packard-Lepere biplane, went up from McCook Field, Dayton, Ohio, on February 26th, and reached the world's record altitude of 33,000 feet.

There were many other experimental flights made successfully. Edward Musick flew an Aeromarine flying boat off the ice at Raritan Bay, N. J., on March 13th, and carried provisions to the steamship *Princess Anne,* stranded near Rockaway, L. I. While the passengers were removed before Musick arrived his flight demonstrated that flying boats could take off and land on ice or snow and that they are invaluable for rescue work at sea.

Realizing the urgent need for laws controlling aerial navigation, several legislatures considered state legislation but the New York State Legislature after considering the subject carefully, adopted a resolution asking Congress to enact a federal law before the States passed conflicting legislation.

Practically the entire country was flown over during the year. Lieuts. H. R. Harris and A. L. Smith on March 8th flew a Martin 12-passenger Army transport plane from Dayton, O., to Washington, D. C., a distance of 385 miles, in three hours and thirty-one minutes. Major L. W. Smith on March 6th flew from Camp Lewis, Wash., to San Diego, Cal., in a Boeing D.H.-4-B plane, 1,160 miles in nine hours and forty-two minutes, most of it over mountain ranges 7,000 feet high.

On March 30th radio communication was established between a submarine and a seaplane at Anacostia, D. C. Roland Rohlfs, former holder of the world's altitude record, on April 12th flew a Curtiss "Wasp" seaplane over a measured course at Rockaway, at a speed of 138 miles an hour. Clifford Webster on April 25th flew a Curtiss H.S.-2-L flying boat with two passengers 1,345 miles from Florida to New York in eighteen hours and twenty-seven minutes. In April, Paul Wilson flew a Thomas Morse biplane from Ithaca, N. Y., to Washington, D. C., and return by way of Dayton, Ohio. An Orenco Tourister piloted by Clarence Coombs on April 30th carried four persons to a height of 17,150 feet.

The first annual intercollegiate championship airplane races were held at Mitchel Field, L. I., on May 7th, Yale, Williams and Princeton winning in the order named.

On May 27th a Dayton Wright aerial coupe reached a height of 19,710 feet with four persons.

On June 12th Donald Hudson in a Curtiss "Wasp" crossed the Andes Mountains at an altitude of 30,000 feet above sea level. On June 27th a Junker monoplane flew from Omaha, Nebr., to Lancaster, Pa., without stopping. On July 3rd Aero Limited flying boats carried a ton of grape fruit from Miami, Fla., to New York in sixteen hours. "The Bankers Special,"

(*Continued on page* 470)

THE NEWS OF THE WEEK

Plans to Fly Over Pole

Philadelphia.—Captain Robert A. Bartlett, who was master of the Roosevelt, Admiral Peary's ship on his expedition to the North Pole, has declared determination to cross the North Pole in an aeroplane.

To finance the expedition, he says, will cost about $300,000, and he is seeking to make arrangements with scientific bodies and wealthy men for the advance of this sum.

Captain Bartlett is known among army, navy and scientific men as "The Polar Bear," and is a veteran of five polar expeditions. He arrived here recently to become Port Captain in the Army Transport Service and is in charge of the transports being completed at Hog Island.

Army Flier Wins Race

Long Beach, Cal.—Flying at 146.8 miles an hour, lieutenant E. E. Bratten, army aviator, won the 100-mile free-for-all race for the Albert H. Hays Challenge Trophy, opening event of the three days' National Winter Air Tournament at Dougherty Field, December 25th. Thirteen fliers started, twelve being army men. Eleven finished.

Lieutenant Bratten's time for the 100 miles, flown over a triangular course, was 40 minutes, 52 seconds. The order in which the other leaders finished, with their time, was:

Captain L. H. Smith, 41 minutes, 37 seconds; Lieutenant Harold Brand, 42 minutes; Lieutenant Y. A. Pitts, 42 minutes, 24 seconds; Lieutenant Milo N. Clark, 42 minutes, 49 seconds.

Lieutenants A. Lee Fosster and R. M. Worthington were forced to descend because of engine trouble. The first six machines to finish were American built, equipped with 400-horsepower Liberty motors.

Chamber of Commerce Offers Camp Kearney Site to Navy Dept.

San Diego's progressive Chamber of Commerce, working for a bigger, better and busier San Diego, has obtained option on 900 to 1,000 acres of land at Camp Kearney for the proposed rigid dirigible station. This land is offered to the government at a rental of $8 per acre, with the proviso that it may be purchased within five years at $100 an acre.

Colonel Ed. Fletcher, chairman of the Chamber's committee, has obtained the necessary agreement from property owners, and the matter has been placed before the Secretary of the Navy for submission to Congress. The proposal was first submitted to the Congressional Committee investigating Navy yards and Naval sites on the West Coast. Ultimate decision, if the proposal is approved by the Navy Department, rests with Congress.

The Camp Kearney site is the most favorable in the vicinity of San Diego, according to Captain J. H. Tomb, commanding the Naval Air Station.

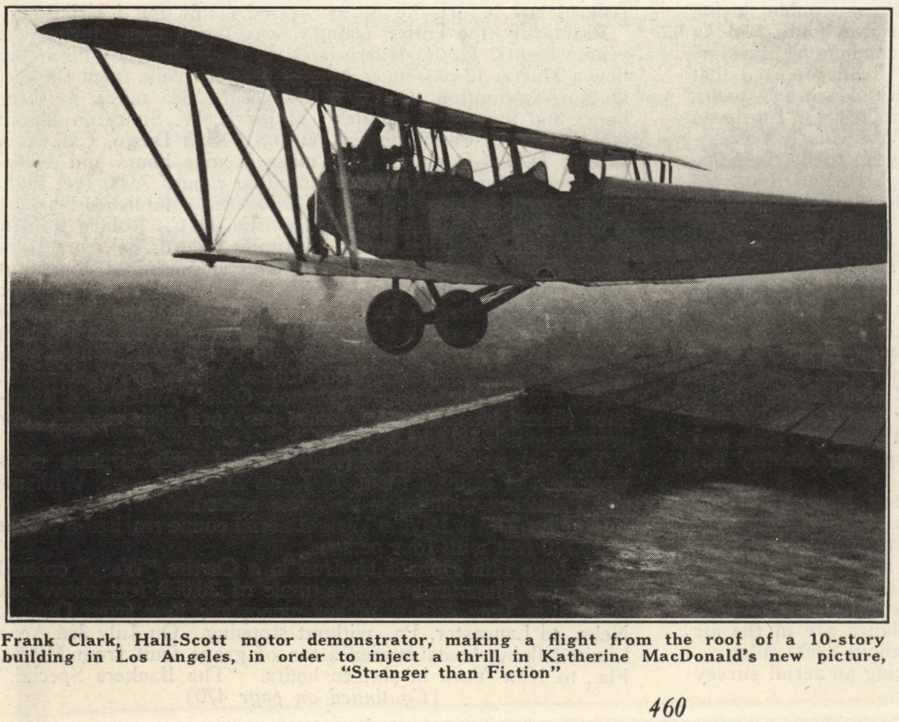
Another proposal has been received from the Aero Club of Southern California offering the transfer of 1,000 acres of flat land eleven miles from San Pedro, Cal., on conditions similar to those at Camp Kearney.

This proposal has not been seriously considered by the Naval authorities as yet, as it was received too late to be submitted to the Congressional Committee while here.

It is expected in event of failure of the Camp Kearney negotiations that the proposed San Pedro site will be given serious consideration.

World's Smallest Triplane

The Italian Government recently offered a prize for the smallest aeroplane which could be operated by a pilot for actual use. The machine which carried off the honors, a Macchi, is only thirteen feet wide and fifteen feet six inches long. It is said to be capable of making a speed of 106 miles an hour.



Frank Clark, Hall-Scott motor demonstrator, making a flight from the roof of a 10-story building in Los Angeles, in order to inject a thrill in Katherine MacDonald's new picture, "Stranger than Fiction"

Aero Club of Minneapolis

The Aero Club of Minneapolis is a live organization, with headquarters at 87 South Tenth Street, and field and hangars at Thirty-fourth Avenue, South, beyond Fifty-fourth Street. The officers of the club are: President, R. R. Rand, Jr.; vice-president, Wm. F. Brooks; treasurer, Harry C. Piper; secretary, Paul Goldsborough. The directors are: Paul W. Louden, H. C. Mackall, M. H. McDonald, Maurice M. Moore, Charles S. Pillsbury, Harry C. Piper, W. D. Prindle, R. R. Rand, Jr., R. G. Robertson, V. F. Rotering, Kenneth B. Salisbury, C. W. Smith, E. R. Tattersfield, Guy A. Thomas, Glenn W. Traer, Jr., S. D. Andrews, Philip J. Barnes, Wm. F. Brooks, Earle Brown, Robert Browning, F. A. Chamberlain, Joseph Chapman, James D. Craig, Matthew D. Crawford, W. W. Eastman, H. M. Gardner, Paul Goldsborough, Murray K. Guthrie, C. T. A. Hart, F. T. Heffelfinger.

Schools Teaching Aeronautics

Following is a list of colleges, universities and schools in the United States offering practical or theoretical courses in aeronautics: Brooklyn Polytechnic Institute, Brooklyn, N. Y.; Castle Girls' School, Tarrytown-on-Hudson, N. Y.; College of the City of New York, New York City; University of Colorado, Boulder, Col.; Kansas State Agricultural College, Manhattan, Kan.; Culver Military Academy, Culver, Ind.; Massachusetts Institute of Technology, Boston, Mass.; University of Michigan, Ann Arbor, Mich.; Pennsylvania State College, State College, Pa.; University of Pennsylvania, Philadelphia, Pa.; Purdue University, Pasadena, Cal.; Tufts College, Tufts, Mass.; State College of Washington, Pullman, Washington; California Institute of Technology, Pasadena, Cal.; College of Engineering, University of South Minnesota, Austin, Minn.; Worcester Polytechnic Institute, Worcester, Mass.

Course Contemplated: Georgia School of Technology, Atlanta, Ga.; University of Illinois, Champlain, Ill.; Iowa State College, Ames, Ia.; Ohio State University, Columbus, Ohio; State University of Oklahoma, Norman, Okla.; Oregon Agricultural College, Corvallis, Ore.; Sheffield Scientific School of Yale University, New Haven, Conn.

Aerial Mail Stamps

Although it is less than four years ago that the first postage stamp especially designed for aerial mail service was issued, it is estimated that, up to the present time, more than forty varieties have appeared, sufficient to make a very creditable specialized collection, and the demand for these stamps is said to be steadily increasing. While many small countries which have done very little to encourage aviation have issued adhesives for aerial postage, Great Britian has thus far refused to issue any special stamps for such use, despite the urging of many philatelic societies in the country.

The first distinct aerial mail stamp on

record was issued in May, 1917, by Italy for an experimental service between Rome and Turin. It was soon followed by another stamp for a hydroplane mail between Naples and Palermo. Two years ago the United States issued its first aeroplane stamp for the service inaugurated between Washington, Philadelphia and New York. The value was 24 cents. The rate was soon reduced. So many of the original issue were printed that uncanceled copies may be obtained without difficulty, but used copies on aerial mail are comparatively rare, especially those bearing the postmark of the first day's service.

Among the countries which have issued aeroplane stamps are Canada, Austria, Newfoundland, Germany, Hungary, Sweden, Switzerland, Esthonia, the United States of Colombia, Tunis and, more recently, the Belgian Congo. The Congo stamps are among the most beautifully engraved of all the aeroplane issues. There are four values, all printed in two colors. The 50-centime stamp is orange and black, showing a native trading station with an aeroplane overhead. The one-franc stamp in purple and black with an aeroplane flying over a village of native huts. The two-franc is blue and black, the scene depicting an aeroplane over a lake on the shores of which are Europeans and natives in long, narrow boats. The highest value, five francs, is green and black, with a view of a square-built tower over which the aeroplane is seen in flight.

For the service established in Spain last April, five of the current Spanish stamps were overprinted in black with the words "Correo Aereo"—Air Post. They are used in the service inaugurated between Barcelona, Alicante and Malaga.

Tunis has just issued its second aeroplane stamp. The first appeared in May, 1919. The new one is a 30-centime stamp in olive and blue, with a view of the ruins of Hadrian's aqueduct. Over the scene appears the airman's winged badge in red.

Aero Club of St. Paul

The Aero Club of St. Paul is organized for the development of commercial aviation, with temporary office at Room 10, State Capitol, St. Paul, Minn. Its membership is growing and the following are officers and directors: President L. P. Ordway, Jr.; first vice-president, Otto N. Raths; second vice-president, S. W. Dittenhofer; third vice-president, Dr. E. W. Bunce; secretary-treasurer, Wm. B. McElveny; directors, Wm. C. Garis, W. A. Kidder, F. A. Nienhauser, and F. C. Hollman.

Pilot Rides Hurricane to Break Record

Jack Knight, air mail pilot, riding a De Haviland four plane, encountered a low-altitude hurricane forty-five miles west of Cheyenne, turned tail into the wind and flew at forty-five miles in seven minutes, or at the rate of 385 miles an hour or six and one-half miles a minute. Over the hangar in Cheyenne Knight faced the wind which exactly counteracted the push of his 400 horsepower Liberty motors and for twenty minutes the machine hung motionless over the landing field. He came down from his 3,000 feet altitude, nose to the wind, by a series of side slips and descended the last 200 feet almost vertically with all power on, landing safely.

Weather Data Available for Aviators

Recognizing the importance to aviators of information concerning conditions in the upper regions of the earth's atmosphere, the Weather Bureau took early action, after the possibility of navigating the air became assured, to develop means for securing a knowledge of these conditions.

Observing stations, equipped with appliances for sending into the upper atmosphere delicate instruments devised to measure the temperature, moisture, and other conditions of the air, were soon in operation. Other means were devised for measuring the velocity of the winds at different levels above the earth, and for studying the directions of the main air streams, and other important facts about the weather, a knowledge of which is necessary to the safety of the aviator and, to the successful application of flying, to the business interests of the country.

Extensive summaries of these investigations, which have been prepared and published from time to time, have been widely distributed.

In addition to a knowledge of the conditions existing at various elevations above the earth, the aviator is much concerned with surface weather, as the success of many of the operations preparatory to flying depends upon the conditions existing in the immediate vicinity of the landing fields, as well as over the territory between.

Data showing in great detail the general surface weather factors for all parts of the country have been prepared by the bureau as opportunity afforded, and these have likewise been given wide distribution.

Copies of practically all climatological summaries may be consulted in many libraries and other public institutions and at the Weather Bureau offices in the United States, about 200 in number, located in practically all the larger cities. Persons desiring weather information may usually find it convenient to call at a local Weather Bureau office, or application may be made by letter, either to the central office in Washington or to the nearest local station.

Prompt information is always forthcoming upon any reasonable request, but inquiries should be limited to actual needs as far as possible.

Arkansas City Aerial Frolic

An aerial frolic, the proceeds of which are to be devoted to the erection of permanent hangars, was carried through at Arkansas City, Kansas, on December 12 and 13. Over eight thousand spectators witnessed the various events and great local enthusiasm prevailed. Most of the army men participating in the event were from Post Field, and they included:

Lieut. Wm. E. Lynd, Lieut. H. A. Johnson, Lieut. Harry H. Mills, Lieut. Joseph H. Davidson, Lieut. Geo. H. Beverley, Lieut. J. T. Morris, Lieut. C. P. Prime, Lieut. Donald Wilson, Lieut. Russell H. Cooper, Chester F. Colby and Everett L. Pond.

Wants An Aeroplane to Carry "Dry" Raiders

Chicago.—Frank D. Richardson, Prohibition Director for this district, said that he was sending an appeal to Washington for an army aeroplane for use in surprise raids on towns like Hurley, Wis., in which the Prohibition law had been broken. "Dry" agents who entered Hurley found the news of their coming had preceded them.

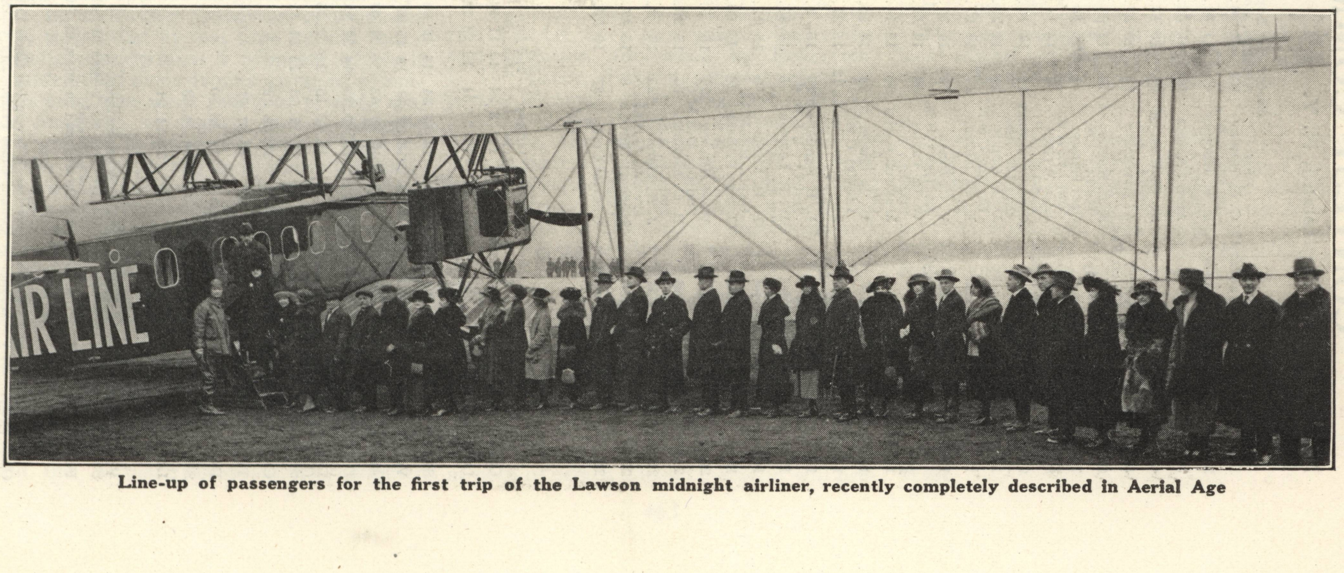
"What we need," Mr. Richardson said, "is an aeroplane. We have the man who can operate it. Captain Lee J. Hanna was a flying man during the war. An aeroplane would also be valuable for patrolling the border and gathering information on booze runners."

Navy Wins Blimp Race at Winter Air Tournament

Long Beach, Cal.—The U. S. Navy won the eight-mile dirigible race at the Winter Air Tournament December 27th, beating a Goodyear pony blimp by one hundred feet.

A Martin torpedo-plane and two Navy Vought machines gave an exhibition of battle tactics.

The three days' flying meet was particularly successful, officials assert. There were no accidents. The various events were witnessed by large crowds, and it is believed that the tournament has materially advanced commercial aviation on the Pacific coast.



Line-up of passengers for the first trip of the Lawson midnight airliner, recently completely described in Aerial Age

CONTEST COMMITTEE'S REPORT OF PULITZER TROPHY AEROPLANE RACE

Mitchel Field, Long Island, N. Y. **November 25, 1920**

CONTESTANTS FINISHING RACE

Position	Aeroplane	Pilot	Racing No.	TIME 1st Lap Min. Sec.	Time for 2nd Lap Min. Sec.	3rd Lap Min. Sec.	4th Lap Min. Sec.	Total Elapsed Time Min. Sec.	Motor	H.P.	Ignition	EQUIPMENT Spark Plugs	Carburetor	Fuel	Oil	Propeller	Thermometer	Tachometer	Air Speed Indicator	Altimeter	Tires
1st	Verville-Packard	C. C. Mosley 1st Lt., A.S.	63	11 6.70	11 0.37	11 7.18	11 15.32	44 29.57	Packard	600	Delco	A-C	Packard	50% Gas 50% Benzol	Mobile B	McCook Field	Boyce	Van Sicklen	Sperry	Taylor	Gdyr Aero Cord
2nd-1st CC	Thomas-Morse	H. E. Hartney Capt., A. S.	41	11 52.31	11 50.09	11 48.80	11 28.83	47 0.03	Wright	300	Dixie Magneto	A-C	Stromberg	80% Gas 20% Benzol	Wolfshead No. 8	McCook Field	Boyce Type C	Sig. Corp Type A	None	Sig. Corp Type D	Goodyear
3rd	Ansaldo	Albert Acosta	56	12 58.14	13 4.05	12 59.91	12 55.52	51 57.62	S.P.A.	225	Olivetti Mag.	K.L.G.	Zenith	68-70° Gas	Oilzum	Ansaldo	Founier	Jaeger	None		Pirelli
4th-2nd CC	(Curtiss) Ordnance	St. Clair Street 1st Lt., A.S.	45	13 13.10	13 16.67	13 3.21	12 44.04	52 17.02	Wright	300	Dixie Mag.	A-C	Stromberg	80% Gas 20% Benzol	Wolfshead No. 8	McCook Field	Boyce	Van Sicklen	None	Type D	Gdyr Aero Cord
5th-1st V	Vought V.E. 7 (Naval Aircrft Fac.)	A. Laverents Lt., U.S.N.	22	13 57.50	13 55.64	13 51.38	13 54.67	55 39.19	Wright	180	Dixie Mag.	A-C	Zenith	68-70° Gas	Mobile B	S-E Prop.	Boyce	Navy	None	Foxboro	Goodyear
6th	DeHaviland (Fisher Body)	J. P. Roullot 1st Lt., A.S.	14	14 35.33	14 15.95	13 48.37	13 26.93	56 6.58	Ford L8berty	400	Delco	Goodnough	Zenith	68-70° Gas	Oilzum	L.W.F.	Boyce	Sig. Corp Type A	None		Goodyear
7th-1st DH	DeHaviland (Curtiss)	Carl Eliason 2nd Lt., A.S.	1	14 11.73	13 53.87	14 0.11	14 3.68	56 9.39	Liberty	400	Delco	B-G	Zenith	68-70° Gas	Liberty		Boyce	Sig. Corp Type A	Foxboro Type	Foxboro	Gdyr. Aero Cord
8th-2nd DH	DeHaviland (Dayton-Wright)	J. B. Wright 2nd Lt., A.S.	2	14 14.89	14 11.00	14 11.28	14 15.03	56 52.20	Ford Liberty	400	Delco	A-C	Zenith	68-70° Gas	Liberty	Eagle Mfg by B. Shoninger	Boyce Model G	Sig. Corp Type A	Bristol		Goodyear
9th	DeHaviland	C.M.Cummings 2nd Lt., A.S.	19	14 18.03	14 18.63	14 15.85	14 15.61	57 8.12	Liberty	400	Dixie	B-G	Zenith	68-70° Gas	Liberty			Sig. Corp Type A	Foxboro Type	Foxboro	Goodyear
10th	DeHaviland	D. L. Conly Lt. (jg) U.S.N.	18	14 29.84	14 25.47	14 22.31	14 23.14	57 40.76	Ford Liberty	400	Delco	A-C	Zenith	68-70° Gas	Mobile BB	Dayton-Wright	Boyce	Sig. Corp Type A	Foxboro		Goodyear
11th	DeHaviland	H. N. Heisen Capt., A.S.	17	14 37.04	14 26.07	14 40.90	14 31.27	58 15.28	Liberty	400	Dixie	Mosler	Zenith	68-70° Gas	Mobile A	McCook Field	Sig. Corp	Sig. Corp	Sig. Corp		U. S.
12th	DeHaviland (Fisher Body)	V. C. Finch Lt. (jg) U.S.N.	3	14 36.87	14 35.60	14 34.16	14 46.31	58 32.94	Lincoln Liberty	400	Delco	Mosler	Zenith	68-70° Gas	Mobile B	Westmore	Boyce	Van Sicklen	Foxboro		U. S.
xx	Ansaldo	W. R. Taylor 2nd Lt., A.S.	54	14 54.64	15 1.57	14 43.36	14 56.02	59 35.59	S.P.A.	225	Olivetti Mag.	B-G	Zenith	68-70° Gas	Oilzum	Ansaldo	Founier	Jaeger	None		Pirelli
13th-1st SE	S. E. 5	Maxwell Kirby Capt., A.S.	35	15 14.47	14 46.04	14 45.43	14 56.73	59 42.67	Wright	180	Simms Mag.	A-C	Zenith	68-70° Gas	Oilzum		British C.S.I. Co.	Van Sicklen	None		
14th-2nd V	Vought V.E. 7	W. B. Gwyn Lt. (jg) U.S.N.	21	14 55.07	14 40.29	14 52.31	15 23.96	59 51.63	Wright	180	Dixie Mag.	A-C	Stromberg	68-70° Gas	Wolfshead No. 8	McCook Field	American Gauge Co.	Jones-B	None	Taylor	Goodrich-U. S.
15th	DeHaviland (Fisher Body)	Lawrence Claude 2nd Lt., A.S.	12	15 21.04	14 49.04	14 47.54	14 59.11	59 56.73	Ford Liberty	400	Delco	B-G	Zenith	68-70° Gas	Liberty	Dayton-Wright	Type D	Sig. Corp Type A	Foxboro		Goodyear
16th	Vought V.E. 7	L. H. Sanderson 2nd Lt., U.S.M.C.	23	15 8.32	14 59.83	14 59.92	15 1.31	60 9.38	Wright	180	Dixie Mag.	A-C	Stromberg	68-70° Gas	Mobile B	Am. Prop. Mfg. Co.	Boyce-Navy Type	Jones-B	Navy-Zahm Type		Goodyear
17th	DeHaviland (Fisher Body)	W. R. Lawson 1st Lt., A.S.	5	14 57.35	15 19.15	15 14.54	15 17.42	60 48.46	Marmon Liberty	400	Dixie	B-G	Zenith	68-70° Gas	Liberty	"Imperial"			None		Goodyear
18th	DeHaviland (Curtiss)	H. B. Mims Capt., U.S.M.C.	6	15 23.19	15 28.69	15 4.33	14 53.13	60 49.34	Liberty	400	Delco	A-C	Zenith	68-70° Gas	Mobile A		Boyce Model C	Sig. Corp Type A	Foxboro		
19th	DeHaviland	Lucas V. Beau 2nd Lt., A.S.	11	15 66.96	14 57.86	14 59.30	14 57.50	61 1.62	Lincoln Liberty	400	Delco	A-C	Zenith	68-70° Gas	Liberty	Eagle Prop. Co.	Boyce	Sig. Corp Type A	Foxboro		Gdyr. Aero Cord
20th	Vought V.E. 7	W. V. Brown 2nd Lt., U.S.M.C.	24	15 5.52	15 32.51	15 35.08	15 12.17	61 25.28	Wright	180	Dixie	Mosler & A-C	Stromberg	68-70° Gas	Mobile B	Am. Prop. Mfg. Co.	Boyce-Navy Type	Jones-Navy Type B	Foxboro		Goodyear
21st	DeHaviland (Curtiss)	R. C. Moffatt 2nd Lt., A.S.	15	15 29.02	15 20.37	15 49.23	15 8.83	61 47.45	Liberty	400	Delco	B-G	Zenith	68-70° Gas	Liberty	Eagle Propeller Co.			None		Goodyear
22nd	Vought V.E. 7	J. K. Dunn Gy Sgt. U.S.M.C.	25	16 2.39	15 36.25	15 7.26	15 4.48	61 50.38	Wright	180	Dixie	Mosler & A-C	Stromberg	68-70° Gas	Mobile B	Am. Propeller Co.		Jones	None		Goodyear
23rd	DeHaviland	Norbert Carolin Capt., A.S.	8	15 47.88	15 49.18	15 43.65	15 18.51	62 39.22	Liberty	400	Delco	B-G	Zenith	68-70° Gas	Liberty		Sig. Corp Type D	Sig. Corp Type A	Type B		Goodrich
24th	Morane Saulnier	Charles Colt	57	16 53.89	16 36.24	19 21.77	20 24.43	73 16.33	LeRhone	110	LKVG Mag.	Mosler	LeRhone	68-70° Gas	Castor	Levasseur	None	Jaeger	None		

CONTESTANTS FAILING TO FINISH RACE

Aeroplane	Pilot	Racing No.	TIME 1st Lap Min. Sec.	2nd Lap Min. Sec.	3rd Lap Min. Sec.	Motor	H.P.	Ignition	EQUIPMENT Spark Plugs	Carburetor	Fuel	Oil	Propeller	Thermometer	Tachometer	Air Speed Indicator	Tires	Reason for Withdrawal
Curtiss Kirkham	W. D. Culbertson 2nd Lt., U.S.M.C.	62	11 3.34	12 11.94	12 18.18	Curtiss-Kirkham	450	Berling Mag.	Mosler	Ball & Ball	68-70° Gas	Castor & Mobile B	Curtiss D.9' P.10 3-4	Boyce	Jones	Sperry	Goodyear	Broken conn. rod; forced landing without further damage.
Loening Special	B. G. Bradley Lt., U.S.M.C.	46	12 38.51	12 25.22	12 35.14	Wright	300	Dixie Mag.	A-C	Stromberg	80% Gas 20% Benzol	Wolfshead No. 8	Hartzell D.8' P.8' 3"	U.S. Navy Type	U.S. Navy Type	None	Goodyear	Alum. water conn. cracked; motor seized; forced landing; landing gear fuselage damaged.
SE-5	A. E. Simonin Lt., A. S.	31	14 57.34	14 46.80	15 5.66	Wright	180	Dixie Mag.					English			None		Pilot believed he had finished race.
Vought VE-7	W. J. Daly Ensign, U.S.N.	26	18 32.59	18 47.92	18 51.63	Wright	180	Dixie Mag.	A-C	Stromberg	60-70° Gas	Mobile B	McCook Field		Jones-B	Zahm Type	Goodyear	Motor overheated; forced landing without damage.
Ansaldo	A. W. Fox	52	13 27.63	15 21.07		S. P. A.	225	Olivetti Mag.	K.L.G.	Zenith	68-70° Gas	Oilzum	L.W.F.	Founier	Jaeger	None	Pirelli	Pilot reported he could not see due to fogged goggles.
DeHaviland (Hospital Plane)	E. H. Barksdale 1st Lt., A.S.	65	15 5.90	14 52.23		Liberty	400	Delco										Returned Mitchel Field.
DeHaviland (Dayton-Wright)	F. O. Rogers Lt., U.S.M.C.	16	15 42.16	15 2.25		Liberty	400	Delco	B-G	Zenith	68-70° Gas			Sperry	Sperry	Sperry	Goodyear	Broken valve, piston, connec. rod. Forced land. without further damge.
SE-5	S. M. Aimes 2nd Lt., A.S.	32	16 7.68	15 51.51		Wright	180	Dixie Mag.	A-C	Stromberg	68-70° Gas	Mobile A	SE Prop		Signal Corp	Markiva		Motor overheated. Returned Mitchel Field.
Curtiss Kirkham	W. B. Haviland Lt. Com., U.S.N.	61	12 35.32			Curtiss-Kirkham	450	Berling	Mosler	Ball & Ball	68-70° Gas	Castor & Mobile B	Curtiss D.9' P.10' 6"	Boyce	Victometer-Jones	Sperry	Goodyear	Carburetor or gas line trouble. Returned Mitchel Field.
Thomas-Morse	Leigh Wade 2nd Lt., A.S.	43	12 37.47			Wright	300	Dixie Mag.	A-C	Stromberg								Broken drift wire. Returned Mitchel Field.
DeHaviland	Davenport Johnson Major, A.S.	7	14 48.80			Ford Liberty	400	Delco	B-G	Zenith	68-70° Gas	Mobile BB	Morris & Co.	Boyce	Van Sicklen	Precision Instr. Co.	Goodyear	Motor went dead, cause unknown. Forced lndng.;'plane badly damaged.
SE-5	F. A. Johnson 2nd Lt., A.S.	34	15 4.23			Wright	180	Dixie Mag.	A-C	Stromberg	68-70° Gas		Liberty	Type A	Van Sicklen	Smith		Motor overheated. Returned Mitchel Field.
Loening	P. E. Gillespie Lt. (jg.), U.S.N.	51	15 11.21			Wright	300	Magneto	B-G	Claudell	68-70° Gas	Wolfshead No. 8					Goodyear	Motor overheated. Returned Mitchel Field.

CONTESTANTS FAILING TO START

Aeroplane	Pilot	Racing No.	
Young Special	O. Young	64	Did not report.
SE-5	F. Steinle Capt., A.S.	33	Did not start—gas in radiator overheated on ground.
Fokker	C. H. Wash Major, A.S.	42	Overturned in snow at Buffalo.
Ordnance	O. C. Kelly 2nd Lt., A.S.	44	Damaged in collision on Mitchel Field before start.
Sopwith Dolphin	C. E. Haynes 2nd Lt., A.S.	47	Did not report.
Loening	J. F. Wolfer Lt. (jg), U.S.N.	55	Damaged in collision on Mitchel Field before start.
DeHav land	R. W. Brown 2nd Lt., A.S.	4	Did not report.
DeHaviland	M. D. Mann 2nd Lt., A.S.	9	Did not report.

1st CC—Winner Contest Committee's Invitation Class Prize. 2nd CC—Second Place in Contest Committee's Invitation Class Prize. 1st DH—Winner of DH Class Prize. 2nd DH—Second Place in DH Class Prize. 1st SE-5—Winner of SE-5 Class Prize. 1st V—Winner of Vought Class Prize. 2nd V—Second place in Vought Class Prize. *x*—Special rigging, not eligible for DH Class Prize. *xx*—Disqualified for cutting pylon at Lufberry Field on last lap.

The Contest Committee believes this report to be accurate, but, as much of the information contained therein had to be obtained from the contestants, mechanicians, etc., there may be some errors. We request anyone finding any errors in the report or having additional information not contained therein, to notify us in order that we may, at a later date, issue a supplementary report.

The AIRCRAFT TRADE REVIEW

Goodyear Wins Point

Columbus, Ohio.—Common Pleas Judge Kinkead on December 23d sustained a motion to quash summons in the suit filed by Frank S. Monnett, a minority stockholder in the Goodyear Rubber Company, asking appointment of a receiver for the company. This nullifies the action in this county, it was said, unless service can be made on an agent.

At the same time the court sustained a demurrer filed by F. V. Freeman, local broker, named in the Monnett suit as a defendant. Freeman asserted he had no connection with the case and should not have been named in the suit.

There are no company agents in Franklin County, it was asserted by counsel for the rubber company, on whom summons could be served.

"Paquito" Dinner

Prominent aeronautical and automobile experts were elaborately entertained at dinner in the Automobile Club of America, on November 23, by E. H. Morrice. During the dinner Mr. Morrice gave a private demonstration of "Paquito," a revolutionary invention for the ignition of explosive engines, a device which if successful will play an important part in the ignition development of all motors.

Brig.-Gen. William Mitchell, Assistant Chief of Air Service; David Beecroft, E. H. Morrice and D. Bruce Morgan spoke. Others included Glenn H. Curtiss, Vital Paquit, inventor of the device; F. S. Duesenberg, Charles M. Manly, Maurice Pereles, Capt. Burdette S. Wright, Fay L. Faurote, W. Kenneth Watkins, L. D. Gardner, Rowland Chilton, H. W. Slauson, J. Tracy, L. M. Griffith and Dr. W. E. Deeks.

Dirigible Operation Laid Over for a Time

Akron.—Ralph Upson, the only American to win the James Gordon Bennett International Balloon Race Trophy, and until recently chief aeronautical engineer of the Goodyear Tire & Rubber Co., has abandoned, temporarily at least, his plans for formation of a large aeronautical syndicate for the manufacture of dirigibles and control and operation of inter-city passenger and express dirigible service. Upson, upon leaving Goodyear two months ago, stated that at that time he had under definite consideration a proposal which it is understood came from a group of prominent men who were ready to provide ample financing, to launch such a dirigible project, and to devote his time to the perfection of an entirely new and more feasible type of lighter-than-air craft.

The current financial and business depression has resulted in deferment of all such plans. Upson is now in Washington in the capacity of consulting aeronautical engineer for the Government, in assisting the Navy and War Departments.

Curtiss Sues Handley Page

New York.—The Curtiss Aeroplane & Motor Corp. has brought two patent infringement suits in the United States District Court against Handley Page, Ltd., and the Airplane Disposal Co., another English corporation. Ten patents are involved in the litigation, which is based on efforts of the defendants to sell in this country surplus war planes which were purchased from the British Government.

Japan Buys Engine Rights

Licenses for the construction of all types of Lorraine-Dietrich aviation engines have been sold to the Imperial Japanese Government. At the present time Japanese engineers and skilled artisans are at the Lorraine-Dietrich factory, near Paris, obtaining instruction in the building of these engines. As soon as sufficiently advanced, it is intended to build the engines in Japan. The Lorraine-Dietrich line consists of 6, 12, 18 and 24-cylinder engines, varying from 150 to 1,000 h.p. The type which is of greatest interest to the Japanese is the 12-cylinder 500 h.p., with Delco ignition. This engine has a bore and stroke of 126 by 200 mm.

Allies Release Planes Consigned to Larsen

New York.—Information has been received that eleven all-metal Junker aeroplanes consigned to the United States but held up at Hamburg by the Inter-Allied Commission of Control, have been ordered released. It has been learned that these machines are being shipped to John Larsen, who is the Junker's representative in this country and who introduced the all-metal planes to the United States by selling them over the counter at $30,000 each to the Post Office Department. It is presumed the machines will come into the country through Baltimore. Larsen, it is said, expects to sell 400 Junker planes in this country before May. Several have been ordered by the Navy Department.

Goodrich Reorganizes Engineering Division

Akron.—Under S. B. Robertson, director of engineering of the B. F. Goodrich Co., who succeeded George Perks in that capacity, the Goodrich engineering department has been reorganized and put upon an entirely new and unique basis, with B. H. Clingerman, formerly managing power engineer, now in the capacity of consulting engineer for the company.

Clingerman has been with the Goodrich Co. for over two years. Under the reorganization announced by Robertson, J. H. Vance, former superintendent of power becomes power engineer. W. C. Hoover is the designing engineer, B. C. Mitchella, the structure engineer, E. D. Barry, material engineer; V. A. Parker, molding engineer, and W. F. Pierce, master mechanic. E. F. Myers and F. E. Blower are assistant master mechanics and W. P. Sheely is chief inspector.

The S. A. E. Aeronautic Sessions

Such a wealth of interesting material has been made available for the S. A. E. Aeronautic Session that it has become necessary to hold *two* Aeronautic Sessions during the winter meeting—one on Tuesday evening, January 11th, and the other on Wednesday afternoon, January 12th—at both of which Glenn L. Martin will preside. The Tuesday evening session will be known as the Aeronautical Engineering Session and will be devoted to papers on recent developments in aviation. Major Thurman H. Bane, of McCook Field, whose entertaining talk and motion pictures at the summer meeting will be remembered, has some new pictures to illustrate his talk on "Progress in Military Aviation." Grover C. Loening's paper will be called "Design Requirements of Commercial Aviation." C. D. Hanscom will give a paper on "Aeroplane Wings" and F. W. Caldwell will tell of recent developments in "Aeroplane Propellers."

"Commercial Aviation Session," is the name given to the Aeronautic Meeting on Wednesday afternoon, in which this subject will be discussed from several points of view. Glenn L. Martin, the chairman of the session, will talk briefly on "Commercial Aviation" in general. Prof. Edward P. Warner, of the National Advisory Committee for Aeronautics, who has recently returned from a trip abroad, will present some first-hand information on "Commercial Aviation in Europe," and Ralph H. Upson has a comprehensive paper on "Transportation of the Immediate Future."

It is to be noted especially that these aeronautic sessions will replace the annual Aeronautic Meeting and Dinner heretofore held at the time of the Aero Show, because of the improbability of there being a Show in 1921.

Personal Pars

Friends of Lieutenant (jg) T. M. Colston, U. S. N. R. F.-5, were pleasurably surprised to learn of his marriage at San Diego, December 8th, to Miss Emma Taylor, of Memphis, Tenn.

First Lieutenant W. H. Bleakley has assumed command of "B" Flight at March Field, vice First Lieutenant H. H. George. Lieutenant Bleakley was one of the first Gosport instructors in this country.

New Company Formed

The Bauhaus Aviation Company of Carpinteria, California, have developed a new two-place type ship which they expect to put into production shortly.

The new company is being backed by local capital and the plant and home office will be located at Carpinteria.

Kinner Leases Field

The Kinner Airplane and Motor Corporation of Los Angeles recently leased their aviation field known as "Kinner Airport" to Miss Neta Snook, who is at present the only lady flyer in Southern California engaged in passenger carrying.

Miss Snook expects to establish about December 1, an aerial tour known as the Orange Empire Air Voyage, taking in the towns of Santa Ana, Corona, Riverside, San Bernardino, Pasadena and Los Angeles.

Miss Snook has the reputation of being one of the best lady pilots in the Middle West.

THE AERONAUTICS OF THE FLYING FISH

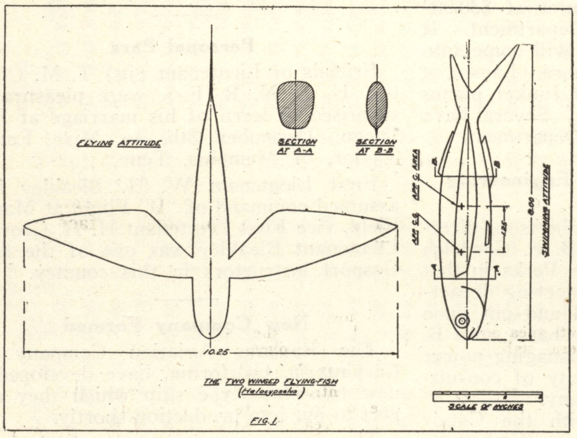
By R. E. DOWD *

WHILE it is generally known that certain species of fish travel through the air with the aid of enlarged pectoral or breast fins, reports of the truly remarkable flights of these creatures are seldom accepted with credence, much less, consideration. Much has been written on the subject from a naturalist's standpoint, but this, unfortunately, has been largely of a controversial nature. The point usually at issue is, whether or not the "wings" are flapped in flight. The writer does not wish to add to the already voluminous literature on this point, but the results of his flying fish study from an aeronautical standpoint have been so intensely interesting to him that he now gathers together his fragmentary notes in the interest of that great unexplored field, Natural Flight.

He wishes to express appreciation of the companionable cooperation and assistance of his friend, John Treadwell Nichols of the American Museum of Natural History, in collecting of data, etc.

There are two families of flying fish—the family Triglidæ or Flying Gurnards, so called, and the family (Exocoetidæ) sometimes called Flying Herrings. The Flying Gurnards, of which there are but few species, have great butterfly breast fins and make only extended leaps through the air. The wings, as might be expected from their low aspect ratio, are inefficient and the performance poor. The other family of flyers, of which there are 50 or more species, is the object of our study. We shall, however, confine our treatise to two very representative species, the first, the Halocypselus evolans, popularly called the Two-winged Flying Fish, and the other (Exonautes speculiger), known as the Four-winged Flying Fish. Both occur cosmopolitan throughout the warm seas.

Fig. 1 is an outline drawing of a fairly representative specimen of the Two-winged species. We are at once impressed with the wonderful streamline body and excellent proportions of this creature, which seems to trespass into the aerial domain with such confidence and success. The lower lobe of the caudal fin or tail is enlarged so that symmetry is no longer present. In passing we might note that this lower lobe enlargement is directly the reverse of the order in tails of the sharks, which, it is generally agreed, are the ancestors of all fishes. Intensive use in sculling the body along close to the water is the reason for this abnormal development. The large shoulder is necessary to house the pectoral muscles and control mechanism, and the unusually large eyes we might expect are the result, in one way or another, of its aerial travels, since they are characteristic of these creatures.



THE TWO WINGED FLYING-FISH (Halocypselus)

FIG. 1.

The arenonautical characteristics of this specimen are as follows:

Span—10.25 inches when expanded to flight attitude.

Length (overall)—8.00 inches.

Aspect ratio—10.25.

Mean chord—1 inch.

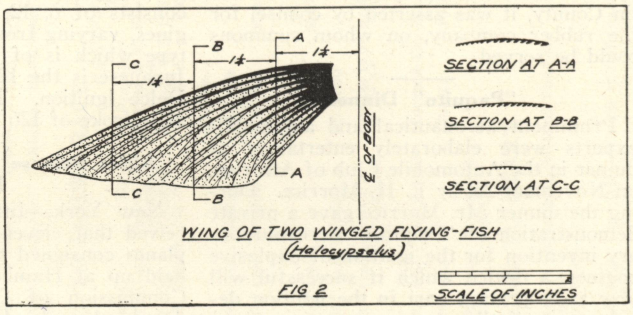
Wing section and construction: Fig. 2 shows the expanded wing in detail. It is composed of a framework of diverging rays which, as they progress outward, divide and branch out so that the total area is very effectively covered. The rays are more or less triangular in section and are covered with a sort of membranous skin on the upper surface. After much difficulty, the writer has secured the reconstructed profiles as shown by imbedding a wing in paraffin and cutting it into sections. The under-surface projections are noteworthy. Without crediting this strange creature with aero-dynamical intelligence, one must acknowledge that Mother Nature has shown better adherence to fundamental principles than did our pioneers, who covered only the lower surface of their wings. When folded, the rays lay very compactly against one another, so that water resistance is minimized.

Weight—.15 lbs.

Area—.071 sq. ft.

Loading—2.1 lbs. per sq. ft.

Velocity. Being greatly variable, the velocity is exceedingly difficult to determine, but careful observation of the relative speed to a ship whose velocity is known puts it at an average of about 30 m.ph. Since the presence of a wind would alter this figure considerably, the matter is largely one of guesswork. However, let us assume for the time being, that it is 30 m.p.h., and enter into a little computation for the purpose of comparison. Not knowing the characteristics of the wing, it is interesting to take the characteristics of a typical everyday section in order to get an idea of the approximate angle of incidence.



WING OF TWO WINGED FLYING-FISH (Halocypselus)

FIG 2

Coefficient of lift, or K_y at 30 m.p.h. must be .0025, which corresponds to about 8.5 degrees for the well known R A F-6 section. This is obviously high, and if the wing is less efficient than the R A F-6, as it probably is, an even greater angle would be required for sustentation. Doubtless, we have underestimated its velocity, although we shall see from its performance that perhaps this particular species is required to use a high angle of incidence though probably not so great as 8.5 degrees.

Performance. A long, though not record, flight of this species and size will be described. Pursued by their nautical enemies, the dolphins or bonitos, they emerge from the water at high speed, spread their pectoral fins which we may call wings and take the air immediately. However, if no danger lurks, the lower lobe is used just after emerging and spreading wings to scull the water in a very vigorous manner so that flying velocity is attained with only air instead of water resistance opposing progress. During this start the wings are often seen to vibrate but only momentarily, for the fish quickly climb upward in graceful swift flight to a usual maximum height of about 12 feet and after a flight of approximately 300 feet or slightly more, re-enter the water with wings folded. Distances much greater and heights up to 25 feet are occasionally recorded, but these are undoubtedly the result of happy-made-to-order air conditions. The quick climb and comparatively short flight would indicate that the incidence and consequently total resistance was high so perhaps our velocity assumption is not so much in error as the high incidence indicated.

The Four-Winged Species

Fig. 3 is an outline drawing of the four-winged species. This species is by far the better flyer. In it we find the ventral or rear fins also enlarged and are of unquestionable value in directing and stabilizing flight as well as furnishing additional lifting area. Its aeronautical characteristics are as follows:

Span (front wings)—12.37 inches.

Length overall—10.50 inches.

Mean chord—1.1 inches.

Aspect Ratio—Approx. 11.

Wings—Same construction as in Two-winged species.

Weight—.27 lbs.

Total area—.112 sq. ft.

Loading—2.4 lbs. per sq. ft.

Velocity—About 45 m.p.h. from extensive observations.

Coefficient of lift or K_y, at 45 m.p.h., .0011. This corresponds to an angle of incidence of about 2.5 degrees for

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* Paper read before Aero Club of Ithaca, Dec. 16, 1920.

R A F-6, a very efficient flying angle which may be taken as the reason for the more extended flights of this species.

Performance. The get-away is very similar to that of the two-winged species, but its long flights sometimes cover distances of six to seven hundred feet at maximum ordinary heights of nine feet. Under windy conditions ¼ and even ½-mile flights have been recorded and heights of 20 feet attained. Often the fish allows its tail to touch the water, after a considerable distance has been traveled, to scull along thereby getting a fresh start for another aerial excursion. The flight following each tail touch is, however, shorter and less energetic, probably due to muscular fatigue.

The Flapping Question

An examination of a flying fish's wing soon convinces one that, ingenious though it may be in structure, it could never reproduce the complicated muscle-propelled cycle called a flap as we see it practiced daily by the smaller flapping birds. Then, too, we have seen that the loading is greater than 2 lbs. per sq. ft., while, in the flapping kingdom, the swallow, with practically equal span and area, is loaded less than a quarter lb. per sq. ft., in accordance with Nature's law "The smaller the flyer, the lighter the loading". It seems that this creature is not intended to propel itself by flapping. An examination of ratio of muscle weight to total weight confirms this belief. The breast or pectoral muscles of a pigeon for example, are equal approximately to 1/5 of its total weight while Dernford gives approximately 1/32 for the same ratio in flying fish. With heavier loading, inferior wings for flapping, and only 1/6 as much proportional muscular energy it is difficut to conceive of real flapping flight by flying fish. What then is the phenomenon that has been so recorded as "flapping" by our conscientious naturalists? The vibrating of the wings, prior to taking the air, Jordan thinks, is the result of the vigorous shaking of the whole body as the tail is propelling the fish. However, as Hankin points out, the vibration is in the horizontal plane and the supposed cause in the vertical plane. In the writer's opinion, if the cause lies in that direction at all, it is due rather to the pectoral muscles' functioning in sympathy with the vigorous exertion of the tail muscles. However, the real explanation seems to be that the noted vibrations, admittedly feeble and small in amptitude, are simply an indication of the feeble control the fish has over its wings until firmly spread and the flight under way. That is to say, the wings are spread, the tail worked for propulsion and when the air is acting properly on the wings, the flight begins. The so-called flapping occurs almost invariably during the critical period after unfurling and just prior to flight. This theory is further strengthened by the not infrequent plunging of the fish back into the water during the "flapping period". This apparent involuntary descent might be attributed to the air's getting into the upper surface before sufficient rigidity had been provided by muscular tension.

Gliding Angle

We have, of course, no exact data on the resistance coefficients of the vaious component parts of these fish, but they conform so closely to tested shapes that computation is possible for an investigation of this nature.

Two-Winged Species

Maximum Sectional Aera of Body—.007 sq. ft.
Fineness Ratio—Approximately 8.
Assumed K_x—.0005.
Velocity—30 m.p.h.
Resistance—

Fins and body.... .003 lbs.
Wings at L of 12 .012 lbs.
D .015 lbs.—Total resistance.

Now if we may use that much debated $\frac{\text{Weight}}{\text{Resistance}}$ for an approximation of the gliding angle we have:

$$\frac{\text{Wt.}}{\text{R}} \text{ or } \frac{.15}{.015} = 10 = \text{Gliding Angle.}$$

Four-Winged Species

Maximum Sectional Area—.0011 sq. ft.
Fineness Ratio—Approximately 8.
Assumed K_x—45 m.p.h.
Velocity—45 m.p.h.
Resistance—

Fins and body .011 lbs.
Wings at L = 16 .016 lbs.
D .027 lbs.—Total resistance

$$\frac{\text{Wt.}}{\text{R}} \text{ or } \frac{.27}{.027} = 10 = \text{Gliding Angle.}$$

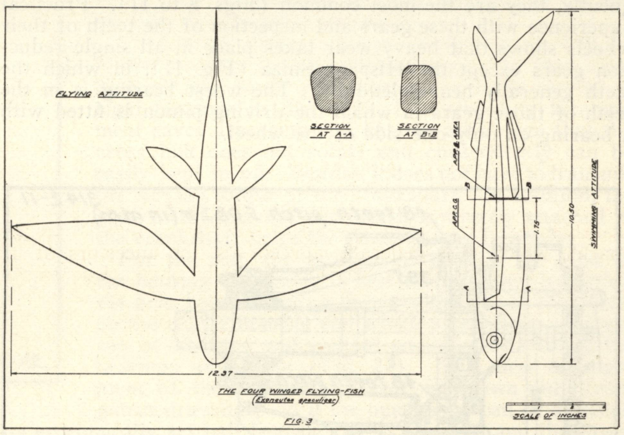
Strangely enough both work out to have a gliding angle of about 1 in. 10, which is of course very good aerodynamically. It is readily seen, however, that at the maximum heights attained, 20 or 25 feet, the performance is a great deal more than a glide. Let us then see if this interesting creature has sufficient control to utilize "wind energy" for it is an established fact that greater distances are covered when flying in a wind.

Control

That the flight is under intelligent and reliable control is certain. The absence of a real trajectory proves that the excursion is a "flight". The distance covered is far too great to be a glide. Therefore, some unaccounted for element enters into the problem. It is that same elusive element that sustains the great 11-foot albatross or the 7-foot Frigate bird hour after hour in effortless flight—the power in moving air. To utilize wind energy without control is impossible. Quite apart from any logical deduction we have the facts before us that longer flights occur in a wind and that fish come aboard ships frequently at night, but very rarely during daylight. Could further proof be desired of the power of controlability? Certainly not, but it will be interesting to see "how" it is accomplished.

The Two-Winged Species

Elevation: Only limited control is possible by changing camber and arching body. This limited control over elevation is fully sustained by observations. The incidence is undoubtedly increased to compensate for reduced velocity.



THE FOUR WINGED FLYING-FISH
(Exonautes speculiger)
FIG. 3

Direction: From Fig 1, we see that the center of lateral area lies approximately 1¼ inches back of the c.g., which would tend to make flights to windward common (as observed). The tail acting as a rudder with much ample keel surface forward makes directional control easy.

Lateral: Probably lateral control is largely inherent because of the extremely flexible wing tips and trailing edge. The lateral moment of inertia is very small which would also aid materially in preserving equilibrium. The enlarged lower lobe of the tail placing the great part of its area below the neutral axis of the body ought to be troublesome to lateral stability, but it is doubtless overcome by intelligent control.

The Four-Winged Species

Elevation: By using the ventral (rear) fins as elevators and by changing camber and incidence to compensate for reduced velocity towards end of flight. The greatly increased controlability of this species seems directly due to the ventral fin development.

Direction: The directional center is about 1¾ inches back of the c.g. and would therefore be favorable to upward flying, as in the two-winged species. The tail is used only for manoeuvers.

Lateral: Same as two-winged species.

Development Noted

As in the study of any living thing, we find organs developed abnormally under intensive use. The tail, the large eyes, the pectoral and ventral fins with their muscles are parts that draw our attention as pure developments. We note that the wings reach only to the base of the tail when folded. Quite logical, for greater length would doubtless hamper free tail action. We also note that when nature turned out a large flying fish, she took care to provide addition control for the inertias must necessarily increase greatly. The body section to the rear changed to rectangular when the ventral fins began to function as elevators. How logical! How mechanically perfect is this creature that many feel trespasses into our new realm of endeavor—the air.

Summary

Thus, we see that the flying fish instead of being a flying creature of feeble, uncertain flight and equally unscientific construction, is really another of Nature's wonderful organisms that actually fly—yes, and apparently evade payment to Father Gravitation for the compensating energy that we are yet compelled to pay for our present mode of flight. Without knowing principles, they use them in a way that man can only marvel at now. In years to come, however, it is the great hope of those who have studied soaring flight, that man will both know the principles and be able to utilize the power of "internal air energy", which seems to be at the complete disposal of so many of Nature's flying creatures.

EXPERIENCE WITH GEARED PROPELLER DRIVES FOR AVIATION ENGINES

By K. KUTZBACH

Translated from Technische Berichte, Vol. III, Sec. 3, by Starr Truscott, Aeronautic Engineer, Bureau of Construction and Repair, U. S. N.

(Concluded from last week)

II. General Arrangement of the Gear

In the construction of the gear drives for aeroplane engines the three principal rules of mechanical engineering apply with special force:

I. All load-carrying parts—gearing and housings—must be joined together in the most direct manner to obtain strength and rigidity.

II. Where a variation in distances between centers is unavoidable as a result of wear, or no exact assembly is possible, suitable provision must be made for adjustments.

III. Where a movement in the gears or housing is unavoidable or cushioning or yielding effect is necessary, sliding or elastic joints must be introduced in such a manner that the effect of the movement or yielding can be accurately determined or computed.

For air propeller drives single or double reduction gear drives can be used. The single reduction gears can be either spur gears, or internal gears, and as a rule work out simpler, lighter and cheaper than the double reduction drives. Consequently, they are the most common (Figs. 8 to 11). Practical experience with these gears and inspection of the teeth of their wheels shows that heavy wear takes place in all single reduction gears except the Hispano-Suiza (Fig. 11), in which the teeth generally bear splendidly. The worst bearing is in the teeth of those gears in which the driving pinion is fitted with a bearing on only one side of the wheel.

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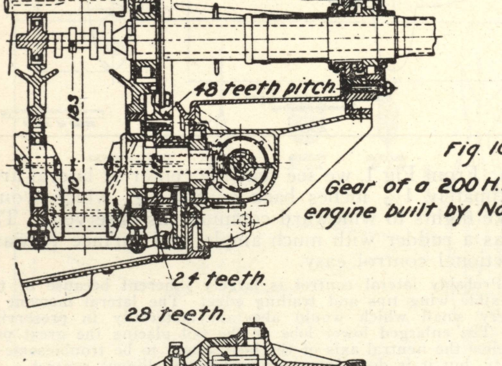


Fig. 10.
Gear of a 200 H.P R.A.F. engine built by Napier.

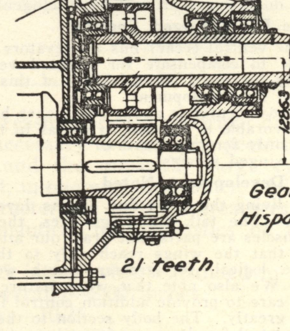


Fig. 11.
Gear of a 200 H.P Hispano Suiza engine.

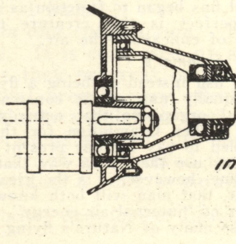


Fig. 12.
Single reduction internal gear by Birkigt.

Fig. 10, 11 & 12

Single reduction gears with internal gearing have not been captured as yet. However, Birkigt, designer for the Hispano-Suiza Works, has had such a gear patented in England (Fig. 12). A notable feature is the attachment of the internal gear housing to the crank case by an eccentric centering flange which makes it possible to accurately fix the play. Against the great advantages of the interial gear must be balanced the difficulty in arranging satisfactory bearings on both sides of the wheels. However, satisfactory solutions of this problem are not impossible.

Double reduction gears with two different pairs of wheels are principally used where the power must be delivered in the same axial line as the crankshaft. Their construction leads to many and varied solutions, since both pairs of wheels may be fitted with internal or external toothing and in addition any one of the three shafts may be fixed while the other two drive and are driven. In this manner alone 12 solutions are found which are assembled diagrammatically, and for a transmission ratio of 1:2, in Fig. 13. The solutions are arranged in the horizontal rows A, B_s, and B_k according to the motion of the intermediate shaft.

Row A Intermediate shaft fixed in housing.
B_s " " revolving with propeller.
B_k " " " crankshaft.

(Rows B_s and B_k illustrate the planetary gears.) In addition, the vertical rows 1 to 4 are arranged according to the direction of rotation of the shafts. As will be understood, all the solutions are not of the same value for actual construction, since in different arrangements the provision of bearings on both sides of the gears makes more or less difficulty, the space occupied may be very great and the revolutions of the intermediate shaft may be very high.

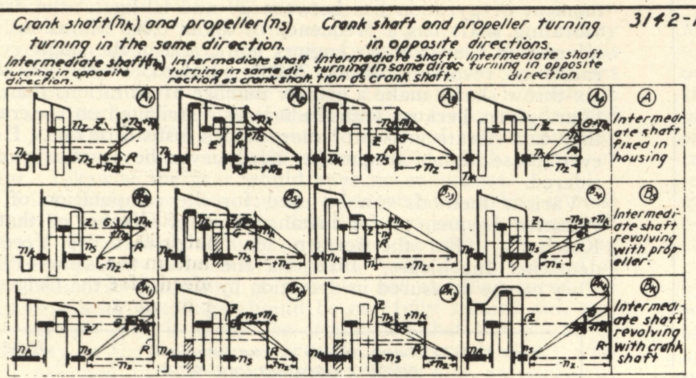
For a better comparison the graphical computation has been added in Fig. 13 for each case. According to the well-known method the r.p.m. of the crankshaft (n_k) and of the propeller (n_s) have been laid off in magnitude and direction (relative to the fixed housing G) at the point G of the intermediate shaft Z (Fig. 14). If the spider R is fixed to the housing its r.p.m. is zero and its origin coincides with G. But, if it revolves itself, with r.p.m. n_k or n_s, then R is applied at the extremity of n_k or n_s (see Fig. 15). The r.p.m. of the intermediate gears relative to the spider R is assumed as to magnitude and direction as convenient. If now the extremity of n_z is joined to those of n_k and n_s, the intersections on the spider indicate the tangent points of the rolling circles.

In addition the double reduction gear can be constructed with spur gears or bevel gears.

The much simpler forms in which both pairs of wheels have one wheel in common form a special case (see Figs. 16 to 19). The form of Fig. 16 is developed from that of form A_1 of Fig. 13, the form of Fig. 17 from A_4, and of Fig. 18 from B_{s2}. It will be observed with this last that the transmission ratio is limited (to about 1:1.5). With the form of Fig. 19 a ratio of only 1:2 is possible.

The Rolls-Royce planetary gear is the best known (Figs. 21 to 23). In many details it is directly representative of the type. It is represented by the form B_{s2} of Fig. 13. The gear a revolves with the revolutions $+ n_k$ of the crankshaft, gears b and c with the relative revolutions $+' n_z$ in the spider i, which is more plainly shown in Fig. 23, and which in turn revolves with the revolutions n_s of the propeller, while gear d is held against revolving in the housing.

The advantage of the double reduction gear over the much simpler single reduction gear lies in the perfectly axial transmission of the power, from which the best condition of loading of the housing—pure torsion—is obtained. If the power is transmitted through 2, 3 or 4 intermediate gears at equal angles springing of the gear shafts from unequal peripheral forces or inaccurate tooth forms does not occur. Certain arrangements also make it possible to use heavy revolving masses; for instance, those of the intermediate shafts or the larger wheels with internal toothing, for the improvement of the uniformity of transmission and to avoid reversals of tooth pressures. The principal advantage, however, consists in the fact that on account of the load being divided between 2 to 4 intermediate gears the tooth pressures per unit of tooth face are very low. Consequently, small pitches and small gears can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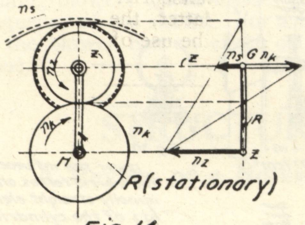
Crank shaft (nk) and propeller (ns) turning in the same direction.
Crank shaft and propeller turning in opposite directions.
Intermediate shaft turning in opposite direction.
Intermediate shaft turning in same direction as crank shaft.
Intermediate shaft turning in same direction as crank shaft.
Intermediate shaft turning in opposite direction
A
B
C
Intermediate shaft fixed in housing
Intermediate shaft revolving with propeller.
Intermediate shaft revolving with crank shaft

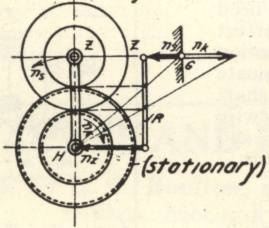
Fig. 13.

Various arrangements of double reduction gears.



R (stationary)

Fig. 14.



(stationary)

Fig. 15.

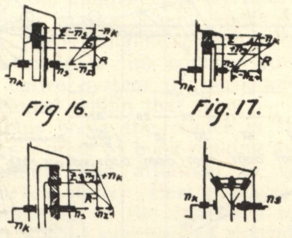


Fig. 16. Fig. 17.

Fig. 18. Fig. 19.

Double reduction gear in which the pairs of gears have a common gear.

Figs. 13, 14, 15, 16, 17, 18, & 19.

be used which in turn have smaller construction defects, since the defects resulting from inaccurate dividing wheels increase with increasing radius. The disadvantage of the double reduction gear is that it is relatively heavy and costly and makes great demand on the accuracy or exact adjustment of the intermediate shafts if all the gears are to work equally. Finally, the solid and secure assembly of the gear make necessary a series of connections which do away with the theoretical simplicity of the type.

In accordance with the first law of light machinery construction—that all load-carrying parts are to be joined together as rigidly and unvaryingly as possible—it is best to fit only ball bearings in the gear case. Then the possibilities of wear and of changing center distances need not be considered, especially if the gears can be fitted in place with the proper clearance. (Note: Sunbeam fits even the crankshaft gear in plain bearings.)

The crankshafts of most of the engines fitted with gears ran in plain bearings which might wear. This was especially the case with engines having six-throw crankshafts. If a bearing ran hot, probably the centerline of the crankshaft after the engine had been overhauled had another position than originally, unless special means to prevent it were provided. Consequently in the Renault, Peugeot, Napier and similar engines ball bearings were used for the crankshaft and in this manner the difficulties resulting from possible change of center distances were avoided. In the Hispano-Suiza engine only the first crankshaft bearing—which also takes the gear pressure—is a ball bearing. At each overhaul the slightly worn plain bearings must be replaced by new ones truly centered.

If it is not desired to go to these measures it is necessary to fit a joint either in the fixed part—for instance, between crank case and gear case (Fig. 24)—or in the transmission between crankshaft and gear (Figs. 25 and 27), which will either adjust itself automatically while running or can be adjusted in assembly. If such a joint adjusts itself automatically, as must be the case when it is fitted between crankshaft and gear, it also equalizes the expansions due to heating of the crank case and gear case and makes the assembly of gear and engine easier. Generally two shafts—or two housings—which are to remain always parallel can be connected by a sliding cross linkage K (Fig. 25), a sort of sliding joint S (Fig. 24), or a floating shaft W (Fig. 26).

The method of the sliding cross linkage has been used in the Rolls-Royce gear—however, in a fixed housing—in a notable manner. The link (Fig. 22) and e of Fig 21 lies between the outer engine housing and the intermediate gear wheel, d, which is held in the housing. Consequently this can adjust itself and always remain concentric with the crankshaft. The whole set of planetary gears also always remains concentric with the crankshaft—which may shift in the casing—but not with the casing. The joint between the fixed gear wheel and the housing is accordingly adjustable transversely in any direction and adjusts itself correctly while the forward bearing g and h must be adjusted on each overhaul of the engine by the adjusting screws f.

In principle this cross link could just as well be placed between crankshaft and gear. In that case, however, the whole gear would have to be carried in rigid bearings in the case. The preceding arrangement saves a bearing and has the advantage that the cross link does not rotate and consequently can be easily kept in oil. Besides, it does not have to transmit the varying torque of the crankshaft. In addition, the mass of the internal gear which is directly attached to the crankshaft helps the smoothness of running.

For the rest, the problem of making the joint in the housing adjustable is best solved either by fitting the gear housing with a flange which is not concentric on the engine housing and which after every overhaul can be adjusted and secured anew, or by making the bearings adjustable (Fig. 27). This new arrangement of the Rolls-Royce gear is known only from patent drawings. In it the upper gear can be adjusted by eccentrically set ball bearing cages, c and d, and the lower gear can be adjusted on the engine shaft by means of adjusting screws. The joint between crankshaft and gear wheel a is a universal one, which is very convenient for assembly.

A gear made by the Friedrichshafen gear factory (Zahnraderfabrik Friedrichshafen) illustrates a method by which the crankshaft can be separated from the rigid gear set (Fig. 28). At the same time it accomplishes the attachment of large rotating masses to the crankshaft, so as to avoid reversals of pressure, and the separation of the irregularities of the crankshaft from the gear. The utility of this type of construction depends principally on the suitability of the type of coupling used.

When long shafts are used between engine and propeller it is best to fit the joints which have been proven by use in automobiles.

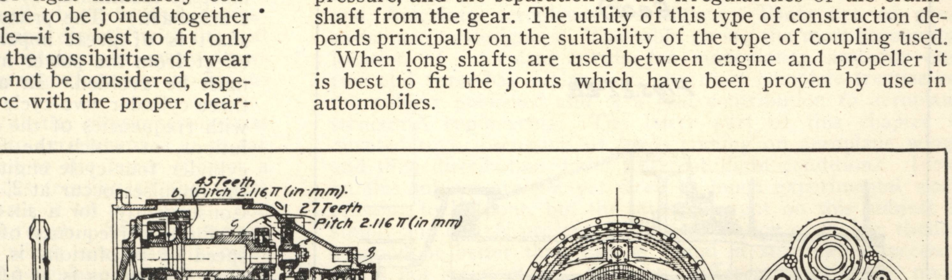


Fig. 21. Fig. 22. Fig. 23.

Section on J.K.L.M.N.O.

Figs. 21, 22 and 23. ROLLS ROYCE PLANETARY GEAR. 3142-11

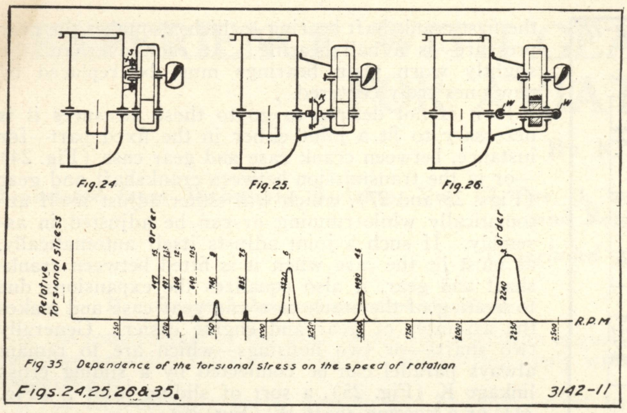


Fig.24 Fig.25. Fig.26.

Fig 35 Dependence of the torsional stress on the speed of rotation

Figs. 24, 25, 26 & 35.

Spring or elastic joints have the advantage that they need no lubrication. They must, however, be absolutely so perfect that their elastic distortion compared to the angular motion allowed is either extremely small or accurately determinate that their influence on the vibration frequency of the shaft can be determined by experiment or computed. Otherwise they may cause great danger to the security of the gear and engine as a result of the possibility of resonance vibrations.

III. Primary Vibrations in the Shaft Transmission.

The primary vibration frequency of a freely vibrating crankshaft, resulting from some passing impulse, is determined partly by the masses involved—that is, the propeller, the pistons, cranks, counter-weights and gears—and partly by the springing of the shafts and gears. In the usual German six-cylinder engines, with moderately heavy air propellers, whose moment of gyration lies between 20 and 60 kg/m² the freely vibrating shaft has a frequency of about 6,000 vibrations per minute; in four-cylinder engines more, and in the single crank radial or revolving, about 20,000. Indeed, freely vibrating six-throw shafts make a greater number of vibrations than the figure given, because with the masses distributed on the cranks they can vibrate in two or more nodes instead of one. However, these higher frequencies need never be practically considered.

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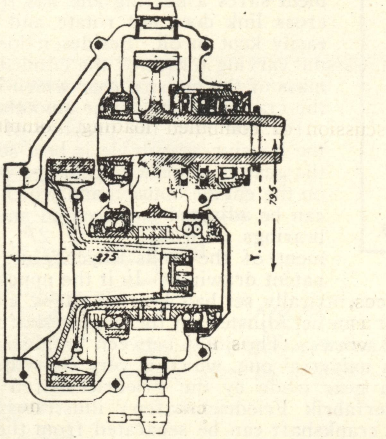


Fig. 28 (The Friedrichshafen Gear Factory Gear.)

Figs. 27-28.

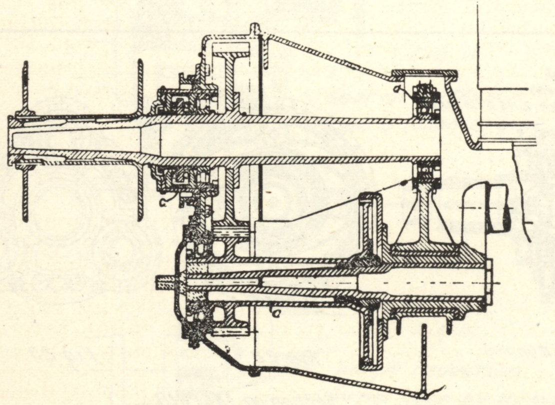
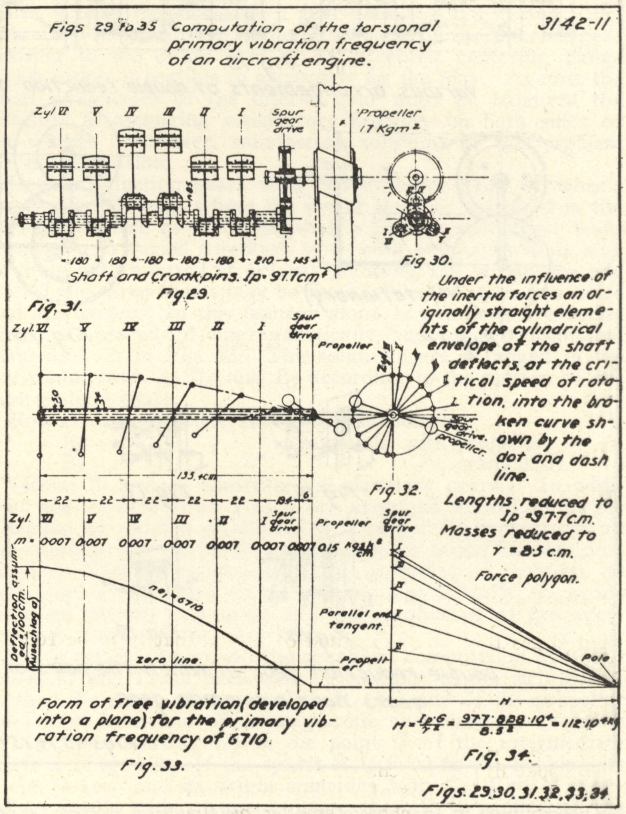


Fig. 27. Rolls-Royce Spur Gear.

Various methods can be used for the computation of the vibration frequency; for instance, that of Gümbel or that of Kutzbach. (For the former, see "Zeitschrift des Vereines deutscher Ingenieure," 1912; for the latter, the same—1917.) They can be measured in operation by the use of the Geiger (³) Torsiograph made by Lehman & Michaelis of Hamburg—which requires a degree of practice in its application—or with the engine stopped. For this a series of light blows at regular intervals is applied to the crankshaft. The vibrations thereby excited in the shaft increase markedly when the frequency of the blows coincides with the frequency of primary vibration of the shaft. (When gears are used contact under pressure must be maintained by suitable springs between propeller and crankshaft.) The primary vibration frequency of the crankshaft is of great importance, since in operation a resonant effect from the power impulses of the engine itself absolutely must be avoided. In a six-cylinder four-cycle engine or a three-cylinder two-cycle engine there occur regular impulses with frequencies of the threefold, sixfold, ninefold, etc., revolutions, of which the first are the strongest. In an eight-cylinder four-cycle engine or a four-cylinder two-cycle engine the impulses occur at 2, 4, 6, etc., multiples of the revolutions. Consequently, for a six-cylinder engine whose crankshaft has a vibration frequency of 6,000 per minute the most dangerous speed of revolutions is 6,000 ÷ 3 or 2,000 r.p.m. The next most dangerous is at 6,000 ÷ 6 = 1,000 r.p.m., etc. It is important that the revolutions ordinarily used shall lie as far as possible from the region of resonance.

Figs 29 to 35 Computation of the torsional primary vibration frequency of an aircraft engine.



Shaft and Crankpins. Ip = 97.7cm⁴

Fig. 29.

Fig 30.

Fig. 31.

Under the influence of the inertia forces an originally straight elements of the cylindrical envelope of the shaft deflects, at the critical speed of rotation, into the broken curve shown by the dot and dash line.

Fig. 32.

Lengths reduced to Ip = 97.7 cm. Masses reduced to r = 8.5 c.m.

Form of free vibration (developed into a plane) for the primary vibration frequency of 6710.

Fig. 33.

Fig. 34.

Figs. 29, 30, 31, 32, 33, 34.

If the diagrams of the individual cylinders are not equal, that is, if, for instance, in an engine with two carburetors, one-half the engine is regularly delivering more power than the other, then not only are the three- and sixfold revolution frequencies, impulse frequencies, but also the four and one-half and ninefold revolution frequencies. Thus 6,000 ÷ 4½ = 1,444 r.p.m. may be dangerous. It is therefore always advisable to keep the primary vibration frequency of the crankshaft of six-cylinder engines above 6,000.

(³) See Z.V.d.E. 1917.

Different builders use elastic couplings between the air propeller masses and the gear masses to improve the uniformity of rotation and protect the gears from torsion. But by that the elasticity increases and the vibration frequency decreases markedly. In a six-cylinder engine, for instance, it would be extraordinarily dangerous if the vibration frequency dropped to 3 × 1,400 = 4,200, on account of the use of such a coupling. The shaft revolving at 1,400 r.p.m. would break sooner or later. Likewise the gear would have no endurance.

If it is desired or is necessary to use such a coupling it must either be made so unyielding that the vibration frequency will always remain high enough or it must be made so yielding that the primary vibration frequency will not be reached at any ordinary speed, and, if possible, not at idling speed. In any case such couplings should be carefully studied out, and for safety's sake it should be established that the degree of elasticity in the coupling as actually constructed agrees with that assumed in the computations. Otherwise an endeavor should be made to get along without elastic members.

This question is also of importance in connection with fast running blowers whose masses completely change the vibration frequency of the shafts. For a ratio i the moment of gyration of the blower has an effect on the free vibrations of the i^2 value.

In Figs. 29 to 34 (based on a communication from the Maschinenfabrik Augsburg-Nurnberg, Augsburg) the vibration frequency of the first degree (primary vibration) of an aeroplane engine and reduction gear is determined graphically. It is assumed that the propeller can be considered as a rigid mass and the gear wheels in actual contact, which is not exactly true. The computation—in which the crankshaft is replaced by a smooth plain shaft of the same value relative to elastic distortion—shows that the primary vibration frequency of the system, consisting of the six driving masses with crankshaft, reduction gear and a certain air propeller, lies at about 6,710.

Fig. 35 shows approximately the influence of the different irregular impulses of the motor torque in the way of exciting resonance if the crankshaft with a primary vibration frequency of 6,710 makes successively from 0 to 2,500 r.p.m. It is based on results from the Torsiograph. It can be plainly seen that between 1,600 and 2,000 r.p.m. the engine is fairly free from critical speeds of rotation and that consequently within this range the gear wheels will be little stressed from vibrations. The critical r.p.m. at n = 1,490 is only the result of unequal work by the different cylinders, consequently is avoidable and works differently in different cases.

STRUCTURAL ANALYSIS AND DESIGN OF AEROPLANES

A Review of a Noteworthy Book by B. C. Boulton, in Charge of Stress Analysis and Structural Design, McCook Field

Assisted by A. S. Niles, Stress Analysis Branch, McCook Field

THE publication by the Engineering Division of the Air Service of this book marks a new epoch in aeroplane structural design. It is tangible evidence of the great advance that has been made in this country during the last three years, for our entire system of aeroplane structural analysis has been developed within that time.

On first examining this book, the reader is struck by its general appearance. As a piece of book-making and as an example of careful planning and attention to typographical details, the book deserves study. Few prefaces to modern textbooks are as illuminating as the foreword to this book, which not only contains a brief summary of the subject matter, but states the general method of attack that is to be followed and emphasizes certain important principles of design. The futility of attempting to economize on the structural engineering on an aeroplane is forcefully suggested. From the table of contents, an idea can be very quickly obtained of the subjects treated. The book is divided into eight chapters and an appendix. The chapters is turn are divided into articles each of which treats of a complete sub-division of the chapter. The manner in which the title of the chapter is given on each left hand page, and the title of the article under discussion together with its number, on the right hand page, is of great assistance in using the book. The complete index makes the finding of even minor subjects very easy. With few exceptions, the photographic illustrations are not only clear but unusually instructive. The neatness and uniformity of the drawings reflects a great deal of credit on the tracer. For a book of this character the number of typographical errors is surprisingly small, which is a tribute to the painstaking proof reading. It is a pleasure in reading this book to find illustrations and tables, with but few exceptions, directly with the text to which they belong. In a volume containing so many drawings and tables securing such an arrangement was no inconsiderable task.

Upon closer study one is struck with the comprehensiveness of the book. Consideration is given to aerodynamics in so far as it concerns structural design, and to the latter subject a good deal of attention is paid, besides treating of the stress analysis of each of the important parts of an aeroplane. The book is both wide in scope and thorough. Some important subjects, such as chassis analysis, which are scarcely mentioned in the few existing texts on aeroplane structures, are gone into exhaustively. One of the most valuable features of this book is the manner in which the application of the principles of analysis is everywhere illustrated in detail by numerical examples. Frequently such examples are of so elementary a character that they afford but slight assistance in the solution of practical problems. In this book, however, the methods are illustrated by analysis of the various parts of actual service aeroplanes. It is refreshing to find that the faithful JN is not the aeroplane chosen. Another important characteristic of the book is its simplicity and its consistent avoidance of difficult mathematics. No knowledge of calculus is necessary to apply practically all the methods given, though elementary calculus is needed to fully understand many of them. The style, in general, is clear and simple. Some of the more difficult ideas require a rereading to grasp fully.

The first chapter makes a bold and rather successful attempt to state clearly all the fundamentals of both applied mechanics and strength of materials. Such a chapter is of particular value to an engineer who has been out of touch with theoretical work and wishes to review the principles quickly. The chapter opens with a statement of the fundamental equations of equilibrium. Then follows a presentation of the various analytical methods for the solution of a truss as well as the standard graphical solution. This is followed by a simple presentation of the beam theory and the methods for calculating moments and next, the application of the three-moment equation is very clearly given. Closing the chapter comes a brief discussion of combined loading, columns, wood and steel in combination, and torsion. The different subjects are not given in a sketchy manner, as would seem almost necessary because of the brevity of the treatment, but are illustrated in detail by examples.

Chapter II deals with a number of general subjects. The more important articles in the first portion of it are those on structural design for maximum visibility, choice of wing sections, characteristics of military aeroplanes, weight analysis of aeroplanes, and location of interplane struts. Under choice of wing sections is given a discussion of suitable criteria to use in selecting aerofoils, the principal properties of some forty aerofoils tested at the Massachusetts Institute of Technology. Complete characteristics and ordinates are given for the six aerofoils selected as the best. The types of aeroplanes to which these sections are best adapted are suggested in a table. In two tables accurate figures for the characteristics and weights of the various parts of a number of both foreign and American aeroplanes are shown. These are of great assistance to designers. The table giving the most economical location of interplane struts for monoplanes, and for one, two and three-bay biplanes, is the most complete treatise on the subject published and is a real contribution to aeroplane structural engineering. The latter part of this chapter is devoted to a discussion of loads coming on aeroplane wings and then distribution under different flight conditions. Ideas on this subject are not yet fixed as much experimental work remains to be done, but the latest thought on this subject is simply and clearly presented. The discussion of diving, though as good or better than can be found in any text at present, yet is not satisfactory. Sufficient differentiation is not made between small and large aeroplanes and the latter would be too heavily stressed. Only pursuit types would be likely to dive at limiting velocity which is the condition assumed for all types. This discussion is followed by a statement of the general methods employed in the usual wing analysis.

In Chapter III the detailed application of these methods is given, the wing cellule of the V. E. 7 being chosen as an example. No mention is made of the British Perry method which is supposed to give an exact solution. The principles outlined in the present book are much less laborious and much easier to understand than those advocated by the British. Yet for certain cases where the spar compressions are large and the slenderness ratio of the spar great, the simple method is inadequate. The last article in Chapter II suggests a comparatively simple and ingenious method for solving such a case. It is correct for the illustration given, but is inaccurate, though on the safe side for spars continuous over one or more supports. From the theoretical rather than the practical point of view the omission of an exact solution for the problem of combined stresses is a serious one. The treatment of stresses due to eccentric strut loads and wire pulls is good. An unusual article is that on multispar construction. The solution offered, while frankly approximate, is very reasonable and should give satisfactory results. In connection with this chapter it may be noted that no methods are taken up for the solution of stresses in incidence or external drag wires. Their effect on the rest of the structure is for the most part neglected.

Chapter IV deals with miscellaneous problems of design. The design of both ribs and struts is well discussed. The types of rib construction given are the result of much experimental work done during the past two years. The problem of attaching the ribs and spars is gone into thoroughly. The formulas and charts for calculating the properties of solid and hollow struts are new and very convenient. In all designs the streamline section described should be used. Tables showing standard practice in the design of incidence and center section cross wires should be useful. The correct methods for splicing spars or longerons and the best types of built up spars are given.

Chassis analysis which forms the subject matter of Chapter V is ably treated. Here especially is evidence of a careful development in theory. It is practically the only real article on the subject. The objection may be raised that it is not worth while to go into an elaborate chassis analysis, but especially in the case of chassis, secondary moments are all important and an approximate analysis on the basis of direct stresses is misleading. The article dealing with shock absorbers is of special interest and will do much to inform designers on this subject.

In Chapter VI is given a detailed analysis of control systems. So frequently these are designed solely by judgment, with result that static tests reveal many failures and weaknesses. Diagrams are given showing the functioning of several types of control systems. Under the heading "Relation of Controls to Pilot", is given a table showing average dimensions for a number of one and two-place aeroplanes. Such a table makes possible the design of a standard cockpit which is so necessary. An interesting example of a sprocket type of aileron control is shown in a drawing and briefly described.

Chapter VII on control surfaces is mainly descriptive. A table is included giving practically complete data on some thirty types of tail surfaces which have been sand-tested at McCook Field. Several principles in the structural design of control surfaces are discussed and illustrated by photographs and drawings. Interesting details of various types of hinges are described. A brief treatment is given of the analysis of control surfaces.

One of the more important chapters in the book is Chapter VIII, which deals with fuselage analysis. There is comparatively little new material in this chapter but the stress analysis of the truss fuselage that is given is very carefully worked out. The ordinary manner in which the computations for the panel loads and the different conditions of loading are presented deserves careful attention. No consideration is given to the problem of obtaining the stresses produced by torque from the rudder load. As these are not especially important, the concentration of effort on the main stresses is probably advisable. No real solution is offered to the problem of designing the longerons after the direct stresses have been calculated. The question involved here is the determination of the proper "fixity coefficients" for the longerons which are designed as columns. No account is taken of the effect of inertia loads in reducing stresses. Because of the uncertainty of our knowledge of these loads, the conservative stand adopted by the authors is well taken.

Some of the most useful material in the book appears in the appendix. The first article, on the calculation of the high speed of aeroplanes, is very good indeed. Following that is a table of strength factors required with different types of aeroplanes for the wings, fuselage and control surfaces. Though these are for military aeroplanes they may be readily used for the corresponding commercial types. The three-moment equations and deflection formulas for continuous beams with various types of loading are a useful and original piece of work. The remaining article is a comprehensive treatment of the strength properties of aeroplane woods. The last portion of the appendix is devoted to a number of valuable tables and charts, none of which are readily available elsewhere. The charts for the calculation of wood, steel and duralumin columns are of special interest.

The Engineering Division is preparing a second edition of one thousand copies of this book principally for use as textbooks. A number of errors discovered in the first edition have been corrected. In its final form this book should be standard for many years.

The reader will notice that several of the more important articles in the book have been published during the past in AERIAL AGE.

(*Concluded from page* 459)

as the Aeromarine F.-5-L. Navy Cruiser was known, flew from New York to Southampton, L. I., on July 30th, with fourteen passengers, a distance of 110 miles, in 72 minutes. Two Junker monoplanes which left New York July 29th arrived in San Francisco August 8th. A Gallaudet Liberty Tourist biplane flew a special edition of the New York *Evening Post* from New York to the Roosevelt notification ceremonies at Hyde Park.

On August 12th Lieut. A. G. Hamilton made a world's record parachute drop, jumping from a plane 20,900 feet in the air over Carlstrom Field, Fla. He reached the ground in twelve minutes.

On August 13th Miss Laura Bromwell broke the world's loop-the-loop record for women at Curtiss Field, Garden City, L. I., looping eighty-seven times in a Curtiss Standard biplane.

On September 5th the U. S. Army Air Service conducted successful experiments with the pitched propeller, stopping planes within seventy-five feet of where the wheels first touched the ground. The same month Californian canneries employed seaplanes in locating schools of fish, reporting larger catches at less cost of time and money.

The New York-San Francisco Air Mail system was opened September 8th. The continued use of aircraft for commercial purposes led the American Legion at its national convention in Cleveland, O., September 28th, to adopt a resolution urging Congress to enact laws regulating aerial transport.

The Gordon Bennett Aeroplane Race was held at Etampes, near Paris, on September 27th. On September 28th an airplane piloted by Paul Collins demonstrated fireproof paint at Curtiss Field, L. I. Air Service officials saw the plane set afire in mid air and fly unharmed until the gasoline, which had been poured over it had burned away. The L. W. F. "Giant" three Liberty-motored bomber, America's largest airplane was accepted by the Army Air Service after trials at Mitchel Field, L. I., September 29th.

On October 21st a group of British scientists sailed from Norfolk, Va., for the Antarctic regions. They carried an airplane with which it is planned to survey the west coast of the Woodell Sea and Graham Land. On October 23rd the "Santa Maria" and "Pinta," Aeromarine flying cruisers, flew from New York to Key West to enter a passenger and mail service between Key West and Havana, Cuba.

On October 28th a Curtiss single-motored Eagle "Aerial Pullman" flew over New York City with nine men and women aboard.

After a series of experiments the U. S. Navy on November 10th announced that the radio telephone could be used from aircraft to landing stations up to a distance of 300 miles.

On November 11th it was announced that the Royal Canadian Mounted Police would in future use aeroplanes and flying boats extensively for outpost duty. Two American Standard Wright machines flew from Nebraska to Mexico City to attend the inauguration of the Mexican president. On November 21st the Goodyear Company established a dirigible passenger service between Los Angeles and Catalina, California.

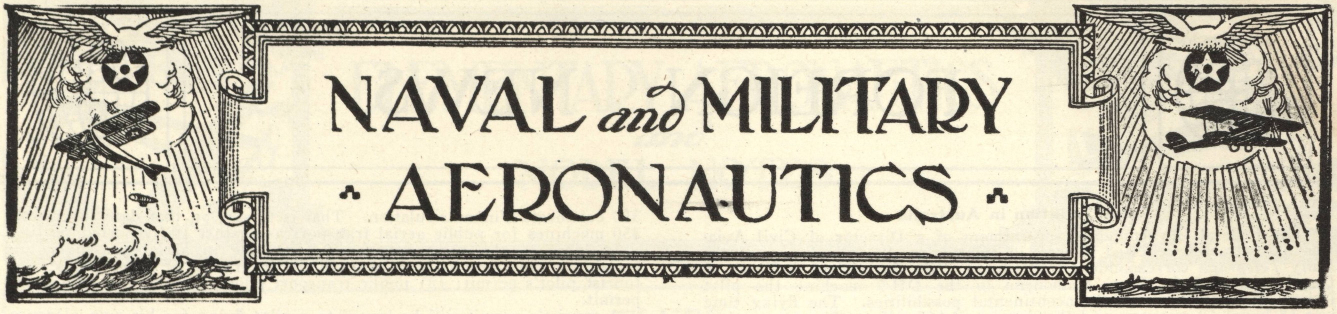
On Thanksgiving Day more than thirty aeroplanes raced over a 132-mile course at Mitchel Field, L. I., for the Pulitzer Trophy. On November 30th the National Aircraft Underwriters Association at its annual meeting adopted a resolution recognizing the increasing popularity of aircraft and urging the need of federal air laws.

Early in December, Pilots Smith and Christenson set a new record for the Air Mail, flying 16,000 letters from Chicago to New York in five hours and fifty-six minutes.

Through the operation in 1920 of a few aircraft lent to the Forestry Service by the Army, approximately $35,000,000 worth of timber was saved from destruction by fire, more than the total Army Air Service appropriation for the fiscal year. About 1,000 fires were reported.

The Wright Aeronautical Corporation of Paterson, N. J., produced a cannon motor discharging 1½" shells through the propeller shaft of an airplane in flight.

A Curtiss Seagull flying boat made a 1,100-mile demonstration flight to all the principal islands in the Philippines carrying mail, passengers and merchandise.



NAVAL and MILITARY AERONAUTICS

Permanent Commissions for N. R. F. C.

In May, 1921, examinations will be held in the Navy for the transfer to appointments in permanent ranks in the Navy of officers holding temporary commissions and members of the Naval Reserve Force. The number of officers so transferred will not exceed 1,200 officers of the line, of which number 500 may be appointed from Class 5, Naval Reserve Flying Corps.

Members of the Naval Reserve Force with commissioned ranks who are not more than 35 years of age, or whose age is not greater than 35 years plus their total former naval service, who qualify by the required examination are eligible for transfer to the permanent commissioned line of the Navy.

The examination will be divided into several general subjects and in the case of examinations for aviation duty, questions on aviation will be substituted for one of these subjects. A knowledge of aviation will, therefore, be of considerable assistance in the examination for aviation duties. It is interesting to note that officers' records will count 200 per cent more than any other subject.

One hundred and thirty-two Naval Reserve officers, Class 5, have applied to take this examination. One hundred and three of this number are on active duty and thirty-two on inactive duty. The Navy Department has sent letters to all Class 5 Aviation officers who are on inactive duty enclosing examination application blanks.

Army Ordnance Association

There has recently been issued the first number of *Army Ordnance,* official publication of the Army Ordnance Association, Munsey Building, Washington, D. C. The magazine is attractive typographically, is handsomely illustrated on good paper, and contains authoritative and interesting articles by General Crozier, Col. J. H. Burns, Col. Harry B. Jordan and others. The officers of the Association are: Benedict Crowell, president; William W. Coleman, vice-president; Ralph Crews, counsel; Charles Elliott Warren, treasurer; James L. Walsh, secretary and editor; Samuel McRoberts, Guy E. Tripp, Waldo C. Bryant, Robert P. Lamont, Frank A. Scott, C. L. Harrison, directors. Capt. Henry Erwin is business manager.

Coast-to-Coast Flight in 24 Hours Planned

San Antonio.—An attempt to fly 2,079 miles from Florida to California in an aeroplane in twenty-four hours will be made February 22 by Lieutenant Alexander Pearson, Jr., Major Henry C. Pratt, air officer of the 8th Corps area, announced Lieutenant Pearson won the transcontinental air race last winter.

The flight will be made in three "hops." The starting point will be Pablo Beach, Jacksonville, Fla. The first hop of 804 miles, will be made to Ellington Field, Houston, Tex.; the second from Ellington Field to El Paso, a distance of 660 miles, and the third is scheduled from El Paso to Rockwell Field, San Diego, Calif., 615 miles.

The flight will be the first attempt to cross the continent for a continuous speed record, the two necessary stops only requiring forty-five minutes.

Experiments in Apparatus for Handling Gas

The experimental station at Fort Omaha is conducting experiments in apparatus for the handling and manufacture of hydrogen gas for balloons. This work is of importance because, with the coming of large dirigibles and the general expansion of the lighter-than-air branch of the service great quantities of this gas at a reasonable price are necessary. Proper equipment for handling the gas insures safety and economy in its use.

The gas used in balloons is frequently stored in cylinders under the high pressure of 2,000 pounds per square inch. Under this high pressure it is difficult to get valves to work smoothly and easily and still be tight in service preventing gas losses from leakage. At this experimental station such valves have recently been designed. Like other good pieces of mechanism, they are comparatively simple in design, and they can be made much more cheaply than the more complicated valves previously in use. In addition they have been especially designed to meet air service demands which require a valve that will vent a cylinder rapidly without freezing up. The standard valve now in use requires seven minutes to completely vent a cylinder, while the present valve developed at Fort Omaha will accomplish this in from 25 to 50 seconds.

Fort Omaha is being equipped with a machine shop which will be suitable for the manufacture on the working scale of much of the machinery being designed there. One of the first pieces of apparatus which will be manufactured in this shop is a hydrogen gas generator known as a silicol generator because of the fact that, in its operation, the hydrogen is produced by mixing ferro-silicon and caustic soda. In this generator are embodied the results of wide experience gained in operation of this type of equipment during the war. Such improvements have been made that the new generator will produce almost twice as much hydrogen from a given quantity of materials as did the older types. At the same time, a generator of a given size will have almost double the capacity of former machines. These improvements will result in great economies and in the production of a machine highly specialized and designed to meet the exacting demands of military field service.

Furthermore, there is ready for test at this station an improved type of electrolytic cell for the production of hydrogen gas. The design of apparatus of this kind requires highly developed technical skill. This particular apparatus, like the silicol generators already developed, is expected to produce many times more gas for a unit of given size than does apparatus of the same type now in use. In present apparatus, a good deal of trouble is experienced with insulation; in the newer design, this will probably be avoided altogether, or at least greatly reduced. The decomposition of water by the electric current is a long established process but, like most similar processes, is susceptible of a good deal of development in the hands of trained engineers. It is an indication of the general progressiveness of the Omaha station, and the air service in general, that technical problems of this kind are being undertaken and that the highest development and the greatest efficiency are the things constantly sought after.

Aviation Depot to Be Expanded

Further expansion of the government aviation repair depot located near the city of Montgomery, to include the supply department now maintained at Souther Field, Americus, Georgia, is indicated in a statement made here by Major W. R. Fitzmaurice, commandant of the depot, to chamber of commerce officials, in seeking ways and means for extending the paved street to the big plant.

An inspector has been sent to the Montgomery plant, it was stated, and communications received from the war department, while not binding, indicated that the proposed consolidation of the two big aviation depots was being seriously considered, and it was pointed out that better facilities for reaching the local shops would have a bearing on a final decision.

Pensacola Notes

In General: Two hundred, seventeen (217) flights were flown in heavier-than-air craft for a total of one hundred eighty-four hours and thirty minutes (184:30).

Rain and squalls retarded flight operations on Tuesday, December 1, 1920.

The following long distance flights were made December 3 and 5, 1920:

F-5-L No. 4009 to Mobile, Ala. and return, December 3, 1920.

F-5-L No. 3669 to Mobile, Ala. and return, December 5, 1920.

Squadron 1: (N-9's) Flying time, 55:30; average number of planes available, 15.

Squadron 2: (HS-2's) Flying time, 34:05; average number of planes available, 5.

Squadron 3: (H-16's and F-5-L's) Flying time, 86:30; average number of planes available, 6.

Squadron 4: (R-6-L's) Flying time, 81:25; average number of planes available, 7.

Number of enlistments during the week as follows:

General Service Ratings	2
Permanent enlisted personnel:	
Heavier-Than-Air Department	289
Lighter-Than-Air Department	178
Gunnery Department	61
Operations Division	108
Medical Department	17
Disbursing Department	36
Special Details (Personnel Officer)	93
Eagle No. 43	30
Eagle No. 53	31
Students under instruction (Enlisted)	35
Students under instruction (Marines)	12
Argentine Petty Officers under instruction	10
Total enlisted complement	895

FOREIGN NEWS

Civil Aviation in Australia

"The Federal Government's appointment of a Director of Civil Aviation has attracted renewed interest in aviation in Australia," reports the *Daily Telegraph* correspondent in Sydney. "By the arrival at Perth of Degaris on a flight from Melbourne in the DH-9 machine the pilot (Lieut. Briggs) indicated Trancontinental possibilities. The flying time was 18 hours 12 minutes, and the distance 2,169 miles. The route taken was via Mildura, the Murray River Valley, Adelaide, over the Transcontinental Railway. The first machine to cross the great Nullarbor Plain left Melbourne on the morning of November 30, and arrived at Perth on December 2 at midday. Degaris, who is a Victorian business man, desired to demonstrate the commercial utility of aviation. Aeroplanes are now frequently used in New South Wales for communication between the country and the town. A machine flew on December 2 in fast time from Sydney to Bathurst, across the Blue Mountains. The new Federal Department should stimulate the movement for connecting remote parts of the continent by air."

A Zurich-Munich Service

The request of the Ad Astra concern to the Swiss Federal Air Department for a concession for an aerial service between Zurich and Munich has aroused some controversy locally. One party urges the Government to be more prudent before subsidizing such a service, while the other side wants to see a network of aerial routes organized and running from a Swiss center.

Germany's Aircraft

A Reuter's message from Berlin states that Air-Commodore Masterman, the president of the Inter-Allied Aeronautical Commission in Berlin, notified the German Government on November 16 that the Ambassadors' Conference decided on November 3 to consider the Spa protocol of July 12 as annulled, and the Boulogne decision of July 27 as being still in force. The Boulogne decision prohibits the manufacture and importation of aeronautical material until three months after Article 202 of the Peace Treaty has been carried out.

[Article 202 of the Peace Treaty provides that, on coming into force of the Treaty, all German military and naval aeronautical material, except the machines mentioned in the second and third paragraphs of Article 198, must be delivered to the Governments of the principal Allied and Associated Powers. Delivery must be effected at such places as the said Governments may select, and must be completed within three months]

As a result of the action taken by the Allies, shipments of German-made aeroplanes intended for the United States and South America have been stopped and foreign orders are being cancelled. In view of the fact that hidden aeroplanes and aviation material are still being discovered in various parts of Germany by the inter-Allied Commission many months may elapse before the building and export of German flying machines is permitted by the Allies.

Handley Page Records

Continental Air Services (in conjunction with Cie. Messageries Aériennes), September 2, 1919-November 27, 1920.

Passengers carried (exclusive of mechanics)	4,139
Freight carried	212,617 lbs.
Mileage covered	319,790 miles

Extension of German Air Mails

The daily air mail between Berlin and Gelsenkirchen is now linked up with the important manufacturing districts within a 20-mile radius of Essen by means of a regular service of motor cycles to which the local mails and parcels are transferred from the aeroplane by the postal authorities on arrival at the terminal aerodrome. The air mail leaves Berlin at 10 a. m. daily and Essen is reached in 2¾ hours as compared with 10 hours by rail. The German Air Ministry are endeavoring to make arrangements for the establishment of an airport at Cologne with a view to linking up that city with direct air services to Paris and London. A regular daily air service has also been decided upon between Königsberg, Munich and Riga for the carriage of passengers and freight. Trial trips have already been made, the whole distance being covered by aeroplane in five hours as compared with three days by the present rail service. The regular air mails will begin next spring. It is also stated that the German authorities have contracted with the Bayerische Rumplerwerke A.G. for a regular daily air mail service between Augsburg, Munich, and Frankfort-on-the-Main. The capital of the company has been increased from M.1,000,000 to M.2,500,000.

French Regulations Issued

The new code of regulations issued in France by the Under-Secretariat for Aeronautics is most complete and shows conclusively the trend toward the development of commercial aviation by government recognition of the industry and the establishing of laws for minimizing the risks. The regulations cover many topics, as air material, personnel, landing places, wireless communications, etc. Government testing of all material will be strictly enforced. A manufacturer wishing to construct a new machine will be required to submit his plans to the technical section of the Air Department. After the plans have been approved, the construction of the machine is supervised, and trials must take place under the direction of a government representative. Should the tests prove the machine to be reliable, the manufacturers will receive a "certificate de navigabilite" and a "certificat d'immatriculation."

Armed with these certificates, he must make application to the National Aeronautical Society for a tag bearing a distinguishing group of letters, arranged much on the same system as motor-car numbers, as many as 16,000 combinations having been arranged for this purpose. The letter "F" showing that all machines are registered in France, precedes every combination. By this system of tags the aerial navigation service is enabled to know at once the registered number of every aeroplane, its owner, the port of registry, the date of its construction, and its history, including repairs, etc. The regulations provide for an inspection of a plane by qualified inspectors after each 100 hours of flight, with a full report entered on the books of the port of registry. Any damage or mishaps, however slight, must be reported, and the machine must be examined by an inspector after it has been repaired.

According to the "Auto," up to September, 1920, there had been issued 350 certificats d'immatriculation. That is to say, on that date there were 350 machines for public aerial transport as against 100 reported in July.

In view of the very considerable increase in aerial passenger and freight service, permits to pilots will, in future, be of three kinds: (1) tourist pilot's permit; (2) public transport pilot's permit; (3) navigator's permit.

A tourist's permit will be issued to a pilot flying for his own pleasure, and not carrying paying passengers or freight. Ample proof of skill in the air will be required before the permit is issued. In order to obtain a public transport pilot's permit, it will first be necessary to hold a tourist's permit, but the test goes a great deal farther, requiring a written examination, and including night flying as well as a thorough knowledge of all the rules of the air.

The navigator's permit will be of two classes, first and second. The first class is for navigators accompanying pilots on long distance flights; the second class is for short distance flights when the pilot acts as his own navigator. Mechanics belonging to the navigating personnel will be required to pass an examination before they are permitted to fly.

Age limits have been fixed for all of these permits: a tourist permit may be granted at the age of 18; a mechanic's permit at the age of 19, while 21 is the lowest age at which the other permits may be obtained.

A very severe medical examination, repeated every six months will, of course, be required of all applicants, and different permits will be issued for aeroplanes and for seaplanes.

These regulations have been drawn up in an earnest endeavor to encourage and facilitate aerial activities, and at the same time, to reduce to a minimum the risk incurred by the general public in making use of air transportation.

France Seeks Fliers To Guard Her Future

Paris.—Although Marshals Foch, Joffre and Petain have declared they do not fear German military invasion of France for many years to come, it is evident that this does not include the possibility of Germany developing a mighty aerial force as the basis of "a war of vengeance" such as was predicted by Andre Lefevre, who resigned the portfolio of Minister of War last week, and his partisans. M. Lefevre's theory is that France requires an enormous standing army as long as Germany is not entirely disarmed.

Not only have arrangements been made to strengthen the aviation branches of the French regular forces but newspapers issue an appeal for volunteers for a new aviation guard which will give France better protection in case Germany's aviation industry is restored to such a point that it will constitute a real menace to the Allies.

The new corps, which will be trained by regular French air officers, will be open to any one under 55 years old whose vision is good and who has fulfilled all his military obligations. At stated intervals the corps will undergo training at the State's expense, although volunteers will have a right to resign from the corps at any time they wish except in case of a state of war, when they will be expected to join on short notice the units to which they have been assigned.

Volunteers will not only act as observers but will be urged to take up intensive courses of training in connection with anti-aerial machine guns, camouflage and the projection of strong light cones and gas clouds.

Japan's Share of German Aircraft

Japan is to receive about 50 machines of recent design, seized in Germany by the Inter-Allied Commission. A considerable sum has been voted by the Japanese Government for the construction of hangars at the military aerodromes of Tokorozawa and Kagamighora; and two airship sheds at Juterbog, near Berlin, are to be taken down, sent to Japan and re-erected with the aid of German engineers. Japan is also expecting to receive one of the Zepplins at Seddin, Pomerania. Thirty British Naval aviators are being loaned by the British authorities to instruct Japanese naval officers in science of aeronautics and aircraft construction. They will report in Japan in the spring of 1921.

Aeroplanes in Forestry

Toronto—The use of hydroplanes and aeroplanes in modern Canadian forestry was one of the subjects discussed at the fall meeting of the Woodlands Section of the Canadian Pulp and Paper Association, held at the King Edward Hotel, on Wednesday and Thursday, December 8 and 9. The Laurentide Company Limited, of Grand Mere, Price Bros. and Company, of Quebec, and the Spanish River Pulp and Paper Mills, of Sault Ste. Marie, Ont., are all employing aerial machines in fire patrol and photography work, and their operatives contributed to the discussion.

Geologists by Air Route

Ottawa—If plans under consideration by the Dominion Air Board are matured, Canadian geologists who every summer make arduous trips to far northern regions to carry on field work, will next summer be spared much effort and saved several weeks of valuable time by being carried in aeroplanes. The first attempt to utilize the flying machines for this practical purpose will be made in the Mackenzie river basin, and the flight will probably be from Peace River Landing, in Northern Alberta, to Fort Norman. The first man to advocate the air route for geologists was Dr. Alfred Thompson, member for the Yukon, who discussed the time-saving possibilities of this plan in the House of Commons two years ago.

Farming in Queensland

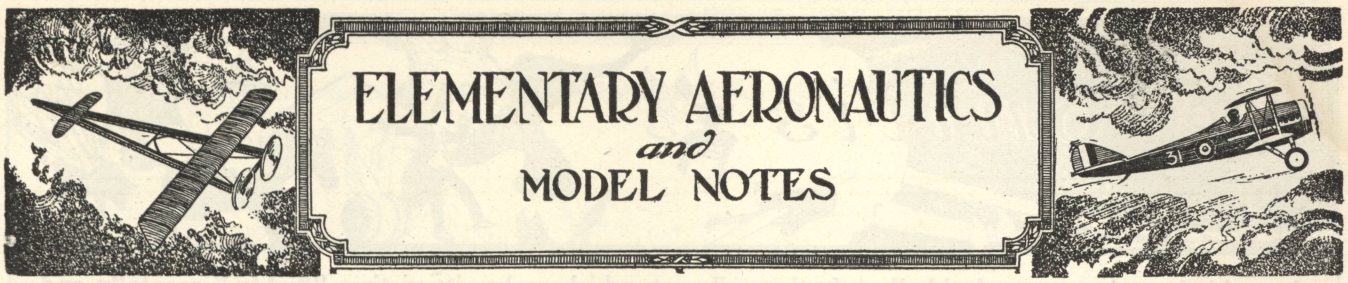
The prediction that aeroplanes would be largely availed of by owners of agricultural and pastoral properties in the western districts of Queensland, is already coming true. A station owner, Mr. T. Behan, of Garfield Station, near Jericho, is reported to have purchased a machine for use in working his pastoral properties, and to keep in touch with his Bilbah Downs, in the Isisford district. The Central Queensland Graziers' Association is also purchasing an Avro 3-seater for organizing purposes. It is suggested that these will be the forerunners of others, and that a company will be promoted to supply machines.

D'Annunzio Quits Fiume in Aeroplane

D'Annunzio has issued a proclamation declaring that it is not worth while dying for Italy. He said he was leaving Fiume by aeroplane.

This was semi-officially announced together with the announcement that the Fiume agreement may be regarded as concluded.

This settlement is based on recognition of the Treaty of Rapallo, disbandment of D'Annunzio's legionaries and general amnesty.



ELEMENTARY AERONAUTICS *and* MODEL NOTES

CLUBS

PACIFIC NORTHWEST MODEL AERO CLUB
921 Ravenna Boulevard, Seattle, Wash.
BAY RIDGE MODEL CLUB
8730 Ridge Boulevard, Bay Ridge, Brooklyn
INDIANA UNIVERSITY AERO SCIENCE CLUB
Bloomington, Indiana
BROADWAY MODEL AERO CLUB
931 North Broadway, Baltimore, Md.
TRIANGLE MODEL AERO CLUB
Baltimore, Md.
NEBRASKA MODEL AERO CLUB
Lincoln, Nebraska
BUFFALO AERO SCIENCE CLUB
c/o Christian Weyand, 48 Dodge St., Buffalo, N. Y.
THE ILLINOIS MODEL AERO CLUB
Room 130, Auditorium Hotel, Chicago, Ill.
SCOUT MODEL AERO CLUB
304 Chamber of Commerce Bldg., Indianapolis, Indiana
MILWAUKEE MODEL AERO CLUB
455 Murray Ave., Milwaukee, Wis.
CONCORD MODEL AERO CLUB
c/o Edward P. Warner, Concord, Mass.
MODEL AERO CLUB OF OXFORD
Oxford, Pa.
CAPITOL MODEL AERO CLUB
1726 M Street, N. W. Washington, D. C.
AERO SCIENCE CLUB OF AMERICA
Beach Bldg., E. 23rd St., N. Y. City
AERO CLUB OF LANE TECHNICAL HIGH SCHOOL
Sedgwick & Division Streets, Chicago, Ill.

The Huntington Motorcycle Engined Monoplane

(*Continued from page* 449)

As an example of the small stresses imposed upon a ship of this size, let us consider the conditions of the rear struts. The center of pressure of the U. S. A. No. 4 section at 2° incidence is 67% of the chord from the leading edge, equivalent to about 36″ for the 54″ chord. The front spar is located 8¾″ from the leading edge and the rear spar 28¾″ behind the front spar. At 2° incidence therefore the rear spar will carry approximately 95% of the total load. Each wing, of course, carries one-half the total weight or 200 pounds. From this we deduct 25 pounds for the weight of the wing, leaving a lift stress upon the wing of 175 pounds. The rear spar carries 175 x .95 = 166.25 lbs., this stress being applied approximately 54″ out on the wing. Since the lift strut is attached to the fuselage at a point 30″ below the wing hinge, the tension in the strut will be approximately 310 pounds, allowing a factor of safety of ten to design fittings suitable for taking the specified load.

Due to the simplicity of the bracing, the wings may be removed from the fuselage by one person in about five minutes and assembled in a similar length of time. As the span occupied by the ship with the wing dismantled is only 5½ x 14 ft., the housing problem holds no difficulties.

Below is a table of summing up the resistances of the various parts of the plane at 52 miles per hour:

1.	Wing Drag	25 lbs.
2.	Fuselage	12 lbs.
3.	Engine Cylinders	3 lbs.
4.	Pilot's Head	2 lbs.
5.	Lift struts and wires	2 lbs.
6.	Chassis	4 lbs.
7.	Empennage	2 lbs.
	Total Resistance	50 lbs.

$$\text{Then, horsepower required} = \frac{\text{R (resistance) V (velocity)}}{375} = \frac{50 \times 52}{375} = 7 \text{ h. p. required at the propeller.}$$

Wings

The wings are built up in the conventional manner, of spruce throughout, with the exception of the rib webs which are of whitewood. Wing beams are not channeled and can therefore be cut to shape on the saw. The ribs are built up with webs ⅛″ thick, lightened, and spruce capstrips, 3/16″ x ⅜″, glued and nailed to the webs. Ribs are nailed to the spars and held in place by triangular blocks. The entering and trailing edges are of spruce.

The drift bracing stresses are taken by struts ¾″ square forming a Warren truss. This method has ample strength for a small ship and has the advantage of cheapness and ease of construction.

The wings are covered with unbleached muslin one yard wide, sewn to the ribs and given three coats of dope. The ailerons are built up and covered similar to the wings; they are hinged to the rear wing spars by eyebolts.

The four lift struts are identical and interchangeable. They are of solid spruce with a Navy No. 1 section as described in Aerial Age, issue of December 29, 1919. These struts have a safety factor of 12 so that an engine of 20-30 h.p. may be installed in the machine if better performance is desired. They are 1¼″ thick by 3¾″ wide and about 6 ft. in length. Pin joints are provided at each end where the struts join the wing and fuselage. Fittings are of cold rolled steel.

For both the wing and undercarriage bracing, 3/32″ cable is used in conjunction with No. 325 turnbuckles.

Fuselage

The fuselage has a length of 12′ 5″, a maximum depth of 33″ and is 20″ wide at the pilot's cockpit. The longerons and struts are of spruce, the former ¾″ square section. Diagonal bracing is of veneer strips ⅛″ x 1″ of greater width at the ends where they are attached to the longerons and struts by wood-screws. This method of bracing has been used successfully on other machines; it possesses the advantage of light weight and low cost since it does away with a considerable number of small parts such as fittings, turnbuckles, clevis pins. shackles, wires, ferrules, bolts, etc.

Standard stick and foot bar controls are installed, the foot bar actuating the rudder. For aileron and rudder, steel tube or ash may be used for control stick, the former being preferable.

The seat is constructed of veneer, well lightened, placed low in the fuselage, 10″ above the lower longerons. In this position the pilot's shoulders come below the upper longerons and consequently a fuselage of less width is required.

Undercarriage

An undercarriage of conventional form is fitted to two well streamlined spruce Vee struts and fastened by fittings of 16 ga. cold rolled steel. The Vees are spaced by an axle streamlined in a lifting wing section, built up of spruce and veneer, a groove running the length of the wing, providing an axle rest. This small wing not only reduces the resistance of the axle but also exerts a considerable lifting force. The axle consists of a length of steel tube 1″ outside diameter by 18 ga. by 46″.

The wheels are standard 20″ x 2″ covered with cloth to reduce resistance.

Empennage

The stabilizer and elevators are built up as flat plates, covered and doped in a manner similar to the wings and fuselage. Eyebolts are used for hinges as in the case of the ailerons and rudder. The control horns are also similar; they are simply a piece of steel tube ½″ o.d. x 18 ga. x 9″ long, flattened at the ends, after heating, and drilled to take the control cable shackles.

Aeronitis is a pleasant, a decidedly infectious ailment, which makes its victims "flighty," mentally and physically. At times it has a pathologic, at times merely a psychologic foundation. It already has affected thousands; it will get the rest of the world in time. Its symptoms vary in each case and each victim has a different story to tell. When you finish this column YOU may be infected, and may have a story all of your own. If so, your contribution will be welcomed by your fellow AERONUTS. Initials of contributor will be printed when requested.

On the Field

Ted—Wish I was in your shoes.
Ned—Why so?
Ted—Mine leak.

Just So

"Why are these little motor wheels like golf players?
"Give it up."
"Why, because they putt, putt, and then miss."

Different Viewpoint

Kaiser—Can you deny that many London citizens concealed themselves underground during the last Zeppelin raid?
John Bull—No, but they didn't hide through fear.
Kaiser—Well, I suppose you call it bravery.
John Bull—No, English conservatism.—*Chaparral.*

Stronger Than Us

Friend—Is that fellow strong?
Mechanic—Well, I guess! I saw him break a dollar the other day.

"How is Blinks, the stutterer, making out in the automobile business?"
"The poor fellow isn't doing so well. You see, he started to sell Stutz's last year and as yet he hasn't been able to gain sufficiently long interviews."

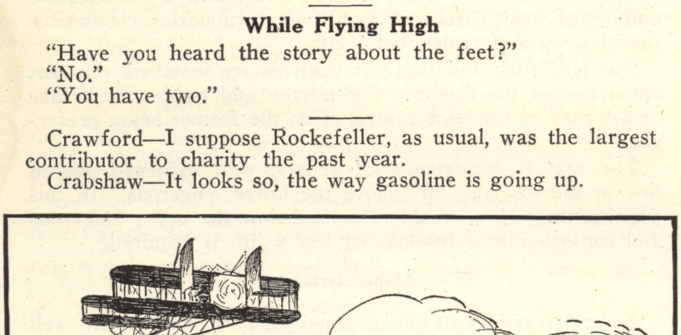
Precisely

Aviator (to his wife)—We're to have cabbage for supper, I knows it.
His Wife—Why, John Henry, what shocking grammar!
Aviator (sniffing the air)—I reiterate, my dear, I nose it.

While Flying High

"Have you heard the story about the feet?"
"No."
"You have two."

Crawford—I suppose Rockefeller, as usual, was the largest contributor to charity the past year.
Crabshaw—It looks so, the way gasoline is going up.



THE POOR DOG.
"I can follow on a run, a high jump or a swim,
But when my master quits the earth I say good-by to him."

"Hello, what course are you taking?"
"B. A."
"What profession are you aiming at?"
"Oh, I'm heading for the bar."
"Wait a second and I'll go along."

"What are the duties of the American soldiers in Mexico?"
"If the press dispatches can be relied upon, a day's work consists of hunting for Villa one hour, hunting for water five hours, and the rest of the time hunting for lost American aviators."

"Yes," said the aviation enthusiast, "I expect to go to Washington and raise my voice in support of aeronautics for the Army."
"Never mind raising your voice," said the other fellow; "stay here and raise funds."

Good Reason

"Aren't you ever worried when you're 'way up there in the clouds?" was asked the daredevil aviator.
"I always am," he replied. "I never can tell until I get down but what my manager has beat it with the gate receipts."

Did you hear that loud report?
Just as we reached the scene
A wind blew through the office
And blew up our magazine.

Help Needed

O'Hoolahan—"Casey is that sthrong he can raise a barrel ov flour right over his head."
O'Rourke—"Sure, that must be some ov that self-raisin' flour."

Fierce Fluids

"What made the trouble for the original inhabitants of America was firewater."
"Yes," replied Mr. Chuggins, "and what is making the trouble for the modern inhabitants is gasoline."

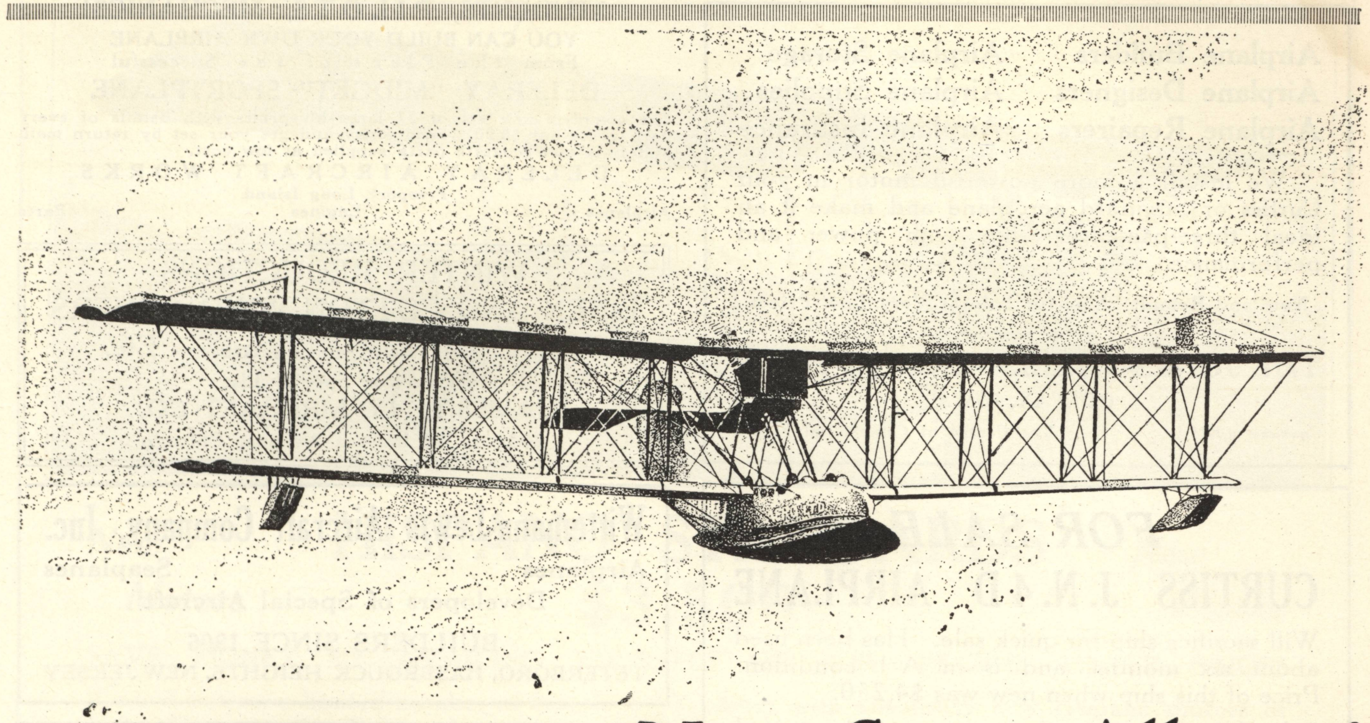
The story is told of an irate officer in an office job during the war who received a letter that got his goat, but remembering his good breeding, he replied:
"Sir, my yeoman (f) being a lady, cannot write what I think of you. I, being a gentleman, cannot think it, but you being neither, will understand what I mean."

Special Correspondence

The following rather amusing letter has been received from one of the prospective clients of the Salina Airplane Company, Salina, Kansas:

Dear Sir:—
Is that the best airplant that you had here in Marion Co.? I would say not. I would say its a daingerest airoplant to have. How are you interested in Airplant that is noiseless, wind doz not go in your face, raises on 10 or 15 feet run, stip the same, with folded wings and only 8 Horse power motor will carry 2 to 3 persons where as with your 80 H. P. motor. this invention in airial plants will be place to you for $500 cash and $25.00 from every airoplant made and sold. if you are interested come to see me or write me now at Lincolnville Kans or week from this date I have call to McPherson Foundry Kansas. you can see me there. I am ready to sign the contract with money refunded if not aproved with above statement to your own aproval in them. your very truly

(Signed) (Name withheld) "Inventor."



Next Stop—Albany!

WHEN the plucky little steamboat *Clermont* paddle-wheeled its arduous course up the Hudson on that historic first trip, people flocked from miles around to jeer at "Fulton's Folly."

Now—more than a century later—we watch the dawn of another new era in transportation, in a kind of matter-of-fact wonder. For every day sees the big flying-boats of "Aero Limited" carrying their passengers on scheduled time safely and comfortably from New York to Albany, to Boston or to Atlantic City, with stops en route.

"Aero Limited" has put air transportation on a practical basis at last.

The *Clermont* was not varnished with Valspar—back in 1807 Valspar was unknown. But 20th Century navigators—whether of water, of air, or of *both*—use Valspar almost to a man. For they know that no other varnish will stand up under the staggering endurance tests put upon it by the rigors of weather and present day travel.

So it's not surprising that every flying-boat in the "Aero Limited" Fleet is "Valsparred—of course!"

Upper photograph—Booking passage to Albany via "Aero Limited" at Main Booking Office, Hotel Waldorf-Astoria, New York.

Lower photograph—Close-up of cock-pit of one of the "Aero Limited" flying-boats.

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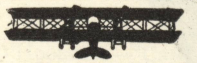

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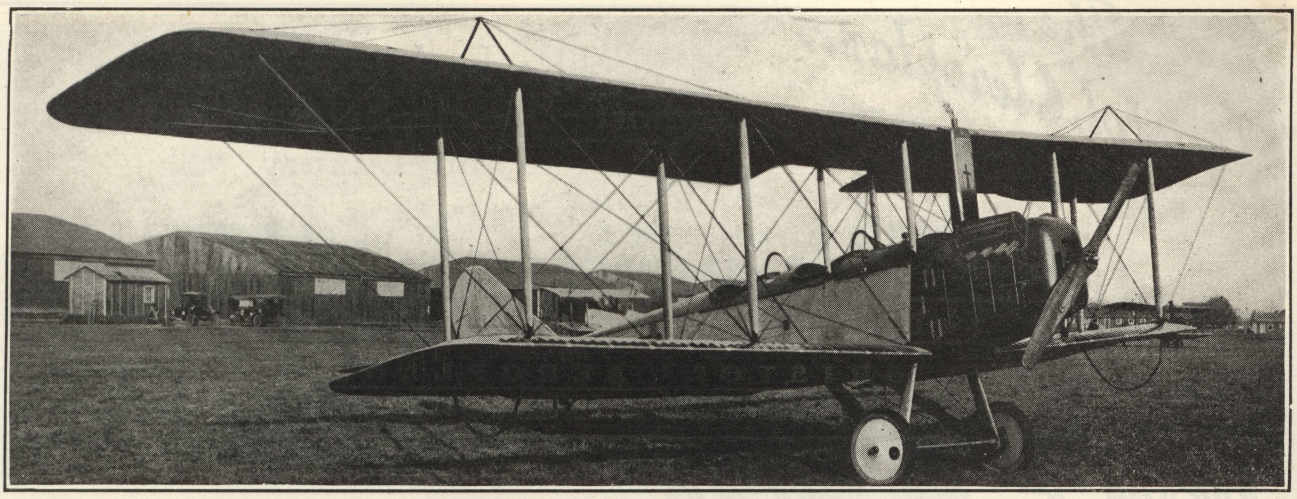
The above items are exceptional bargains and are made up to the high Government standards and specifications. Send your orders to **Max Topper and Rosenthal, 11th Ave. and Penna Tracks, Columbus, O.**



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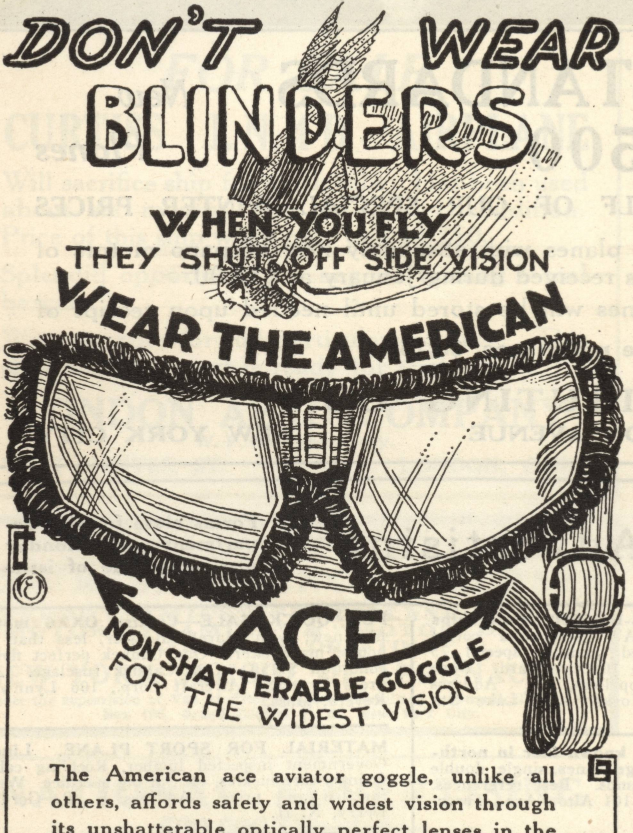

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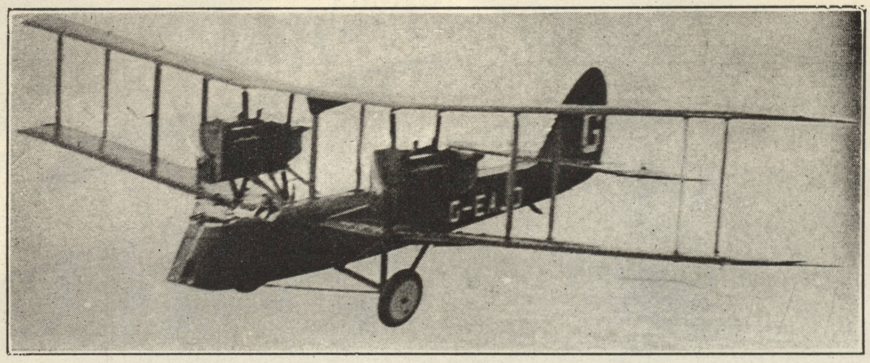

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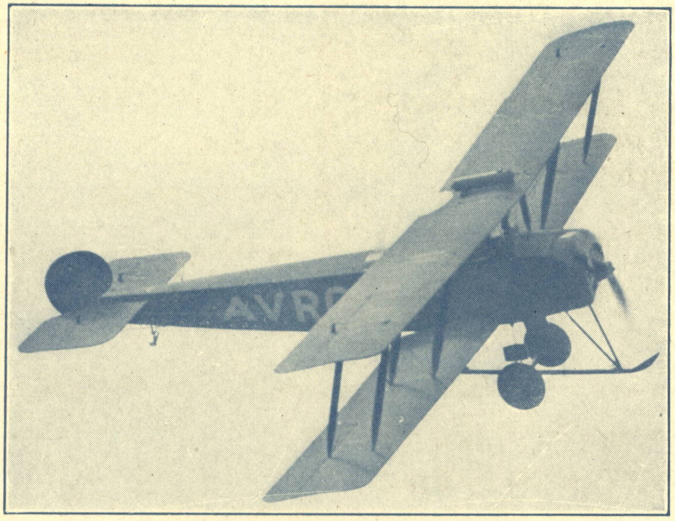

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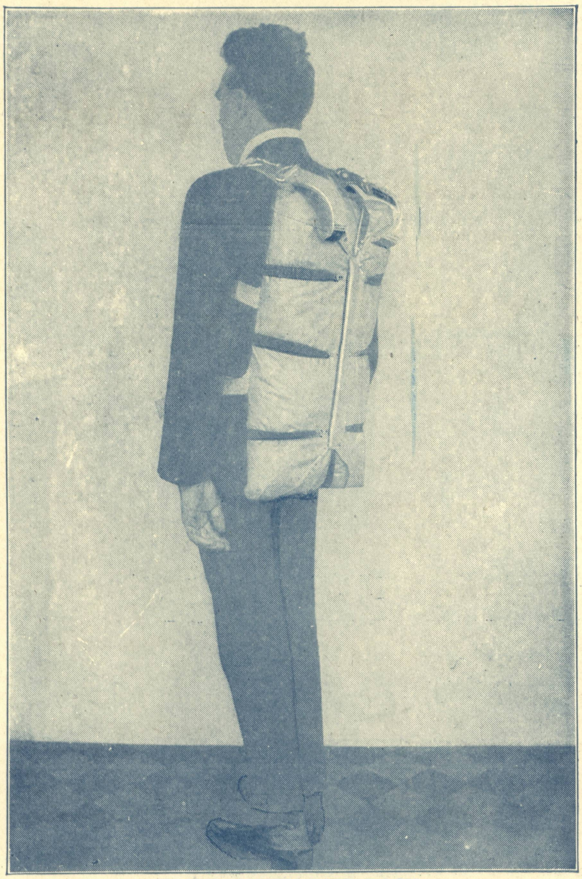

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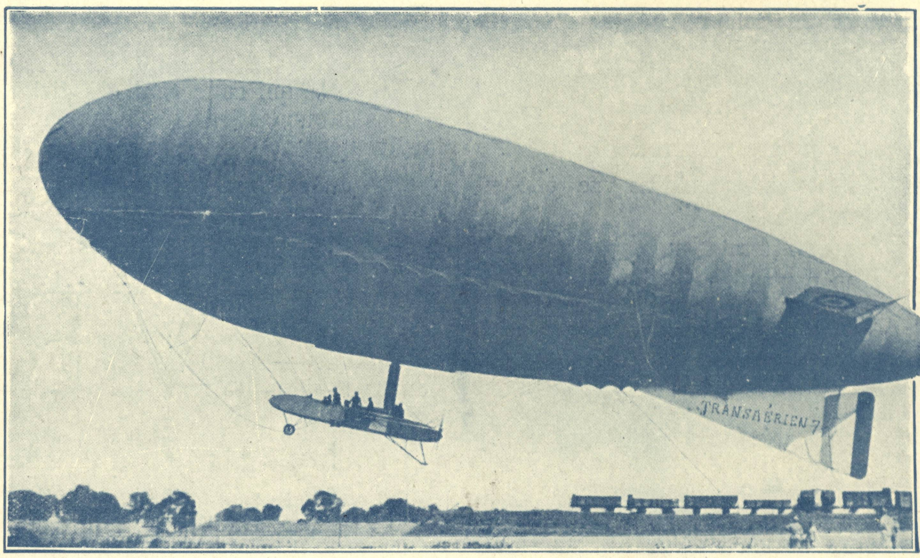

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